JANUARY 1960

Radio-Electronics

HUGO GERNSBACK, Editor

eries: Design Your Own Preamplifier

pair Your Own
t-Ohm-Milliammeter

w Infrared
ides Missiles

ter Servicing
Record Changers

Citizens Band
Radios
Constructed
from Kits

See page 110

re Articles on
ustrial Electronics

BOB G MARRENHOLZ 4-63
624 CIRCLE DRIVE
TULAHOMA TENN

HERE'S A COMPACT DESIGN

that's preferred among all modern designs!

IT'S THE SLIM, TRIM NEW 330 MICROPHONE SERIES

Dynamic, Ceramic and Crystal Models

BY ASTATIC

ACTUAL SIZE

never before such quality of performance and versatility of application at such low price

Yes, here's a classic design in modern, compact microphones—small, slender, unobtrusive, a beauty in simplicity. But the greatest achievement is in the magnificent performance quality of the Series among a great host of applications.

The Dynamic Models 335H (high impedance) and 335L (low impedance) operate with highest quality characteristics in TV and radio broadcast usage, in professional or home recording, public address, almost unlimited other lavalier, hand or stand applications.

The Ceramic Model 331 is a voice range unit specifically engineered for excellence in communications applications, 27 megacycle citizens' band use, and paging.

Ceramic Model 333 is a wide-range microphone offering a similarly high new level of perfection for tape recording, P. A. Systems, etc.

Crystal Model 332, with satin chrome body and cap, black grille, is already famous through widespread use. Performance throughout the series is of the highest order. THUS, THE GREATEST NEWS OF ALL CONCERNING THESE NEW ASTATIC UNITS IS THEIR AMAZINGLY LOW COST! Check out these new Astatic Microphones at your first opportunity.

Model	Type	Output	Frequency Range	Impedance	Finish	List Price
331	Ceramic	-56 db	300- 5,000	High	Black Body and Grille, Chrome Cap	$17.90
333	Ceramic	-58 db	30-12,000	High		17.90
335H	Dynamic	-56 db	50-12,000	High	TV Grey Body, Chrome Cap and Grille	26.50
335L	Dynamic	-57 db	50-12,000	Low		23.50

NOTE: Model 331 has momentary-on, spring-return switch, is furnished with hang-up bracket. Cable provides for audio and relay connections. All other models have slide switch with "lock-on" position, are complete with lavalier and stand adaptor with 5/8"-27 thread.

GO BY BRAND . .
GO BUY ASTATIC

THE Astatic CORPORATION, CONNEAUT, OHIO

KNOWN THE WORLD OVER

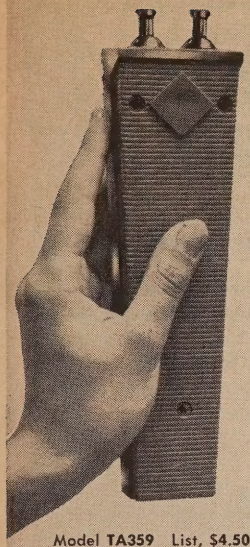
In Canada: Canadian Astatic Limited, Toronto, Ontario

Export Sales: Roburn Agencies, Inc., 431 Greenwich St., N. Y. 13, N. Y., U. S. A.

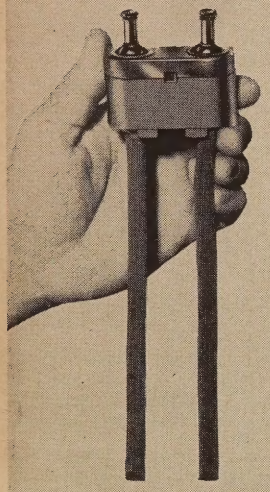
WHERE WOULD YOU GET **ANY** AND **EVERY** ANTENNA REPLACEMENT FOR PORTABLE AND TOTEABLE SETS?

JFD*

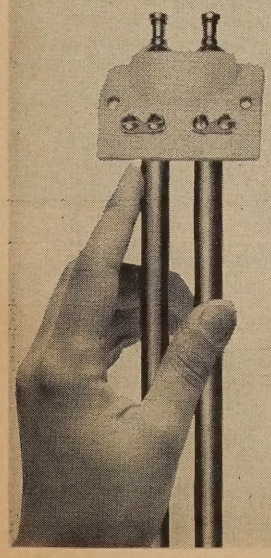
OF COURSE!



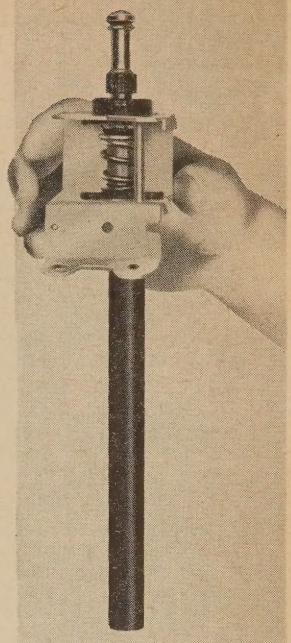
Model **TA359** List, $4.50
Exact Replacement for RCA, Motorola, Magnavox, 1956-7-8 Portable TV Sets



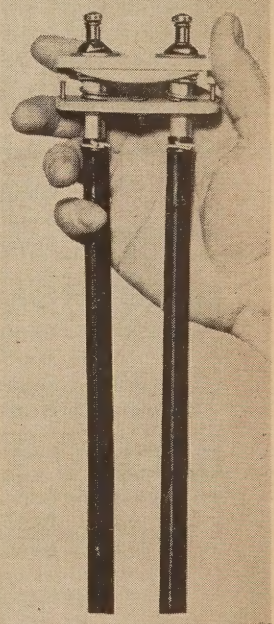
Model **TA362** List, $9.75
Exact Replacement for GE Designer and Hotpoint "Flair" 1958 Portable TV Sets



Model **TA369** List, $8.25
Exact Replacement for RCA 1960 Portable TV Sets



Model **TA370** List, $6.25
Exact Replacement for Admiral 1959-60 Portable TV Sets



Model **TA360** List, $7.65
Exact Replacement for GE, Hoffman, Hotpoint & Emerson 1957-8 Portable TV Sets

Only when you buy a JFD Exact Replacement Antenna do you get the original unit that JFD supplies to manufacturers for their TV portable or "tote-able" sets. And when you install a JFD Exact Replacement Antenna *you* make a *full* profit on the sale and the installation—bring customers back to *your* shop because only you are equipped to replace a broken antenna.

Only $11.95 puts you back in profitable indoor antenna business. That's all it costs for the No. PA500 JFD Exact Replacement Antenna Merchandising Kit that gets you started in this new multi-million dollar service market.

Remember, next to receiving tubes, the antennas of portable and "tote-able" sets require the most frequent replacement.

See your JFD distributor today for your PA 500 kit and any and every antenna replacement need.

*Beginning with set #467 in December, JFD Exact Replacement Antennas will be listed in SAMS PHOTOFACT folders for your service reference.

Pioneers in electronics since 1929

JFD ELECTRONICS CORPORATION
6101 Sixteenth Avenue Brooklyn 4, New York

JFD CANADA LTD.
51 McCormack Street
Toronto, Ontario, Canada

JFD INTERNATIONAL
15 Moore Street
New York, N.Y.

OVER 50 YEARS OF ELECTRONIC PUBLISHING

JANUARY, 1960

Radio-Electronics

Formerly RADIO-CRAFT ■ Incorporating SHORT WAVE CRAFT ■ TELEVISION NEWS ■ RADIO & TELEVISION

EDITORIAL

31 Automation in Electronics—Hugo Gernsback

INDUSTRIAL ELECTRONICS

32 Setting Up an ITV Camera—Edward M. Noll
36 Electronics Goes Fishing—S. M. Milanowski
38 Photoelectric Register Controls . . . How They Work—Allan Lytel
42 TV Tech to Military Technician—Edwin N. Kaufman

TELEVISION

43 TV Tuner With a Guided Grid—E. D. Lucas, Jr.
46 1960 TV Design Trends, Part II—Wayne Lemons
49 FM-TV Dx in 1959—Robert B. Cooper, Jr.
50 TV Service Clinic—Conducted by Jack Darr

AUDIO-HIGH FIDELITY

53 Design Your Own Preamp, Part I—Norman H. Crowhurst
56 Headphones for TV—William B. Rasmussen
57 Servicing Record Changers Faster—P. Sheneman
59 Wired Broadcasts in Italy
60 What Is an Output Watt?—Charles B. Graham
61 New Discs and Tapes, Stereo and Mono—Reviewed by Chester Santon
62 Transistors in Audio, Part II—Herbert Ravenswood

TEST INSTRUMENTS

74 Fix That Multimeter—Edwin Bohr
82 Multipurpose Transistor Crystal Oscillator—F. T. Merkler
84 Ohmmeters Can Be Accurate—H. B. Conant
90 Sound-Intensity Indicator—Wm. R. Shippee
91 Square-Law Audio Millivoltmeter—Rufus P. Turner

ELECTRONICS

96 Infrared Guides Missiles—James R. Spencer
98 More Hints From a Transithusiast's Workshop—Martin Klein
105 Something New in Semiconductors — R. Wayne Crawford and Neal P. Milligan

RADIO

108 Conelrad Alert Monitor—Harold Reed
110 Building Your Own Citizens Radio (Cover Feature)—Leo G. Sands
124 Eliminate FM Auto Radio Interference—Larry Steckler

149 Business and People
91 Corrections
21 Correspondence
152 New Books
146 New Literature
142 New Patents
133 New Products
127 New Tubes and Semiconductors
6 News Briefs
139 Noteworthy Circuits
130 Technicians' News
140 Technotes
144 Try This One
107 50 Years Ago

ON THE COVER

(Story on page 110)

The author's son proves that at least some of the operations of wiring up a Citizens radio set are so simple as to be boy's play.

Color original by Jacques Saphier

Hugo Gernsback ..... Editor and Publisher
M. Harvey Gernsback ..... Editorial Director
Fred Shunaman ..... Managing Editor
Robert F. Scott ..... W2PWG, Technical Editor
Larry Steckler ..... Associate Editor
Charles B. Graham ..... Associate Editor
I. Queen ..... Editorial Associate
Elizabeth Stalcup ..... Production Manager
Wm. Lyon McLaughlin .... Tech. Illustration Director
Sol Ehrlich ..... Art Director
Fred Neinast ..... Staff Artist
Lee Robinson .... Director, Advertising Sales
John J. Lamson ..... Eastern Sales Manager
G. Aliquo ..... Circulation Manager
Adam J. Smith .... Director, Newsstand Sales
Robert Fallath ..... Promotion Manager

Audited Paid Circulation ABC

Average Paid Circulation
Over 187,000

Member Institute of High Fidelity Manufacturers Inc.

RADIO-ELECTRONICS is indexed in *Applied Science & Technology Index* (Formerly *Industrial Arts Index*)

RADIO-ELECTRONICS, January, 1960, Vol. XXXI, No. 1. Published monthly at Mt. Morris, Ill., by Gernsback Publications, Inc. Second-class postage paid at Mt. Morris, Ill. Copyright 1959 by Gernsback Publications, Inc. All rights reserved under Universal, International and Pan-American Copyright Conventions.
SUBSCRIPTION RATES: U.S., U.S. possessions and Canada, $4.00 for one year; $7.00 for two years; $10.00 for three years. Pan-American countries $5.00 for one year; $9.00 for two years; $13.00 for three years. All other countries $5.50 a year; $10.00 for two years; $14.50 for three years.
SUBSCRIPTIONS: Address correspondence to Radio-Electronics, Subscription Dept., 154 West 14th St., New York 11, N.Y. When requesting a change of address, please furnish an address label from a recent issue. Allow one month for change of address.
GERNSBACK PUBLICATIONS, INC. Executive, Editorial and Advertising Offices, 154 West 14th St., New York 11, N.Y. Telephone Algonquin 5-7755. Hugo Gernsback, Chairman of the Board; M. Harvey Gernsback, President; G. Aliquo, Secretary.
BRANCH ADVERTISING OFFICES and FOREIGN AGENTS listed on page 157.
POSTMASTER: If undeliverable, send Form 3579 to: RADIO-ELECTRONICS, 154 West 14th St., New York 11, N.Y.

*Trademark registered U. S. Pat. Office.

NOW! at a price you can afford!

MAKE MORE MONEY in TELEVISION RADIO-ELECTRONICS

BETTER...MORE COMPLETE...LOWER COST... WITH NATIONAL SCHOOLS SHOP-METHOD HOME TRAINING!

BETTER... Training that is proved and tested in Resident School shops and laboratories, by a School that is the OLDEST and LARGEST of its kind in the world.

MORE COMPLETE... You learn ALL PHASES of *Television-Radio-Electronics.*

LOWER COST... Other schools make several courses out of the material in our ONE MASTER COURSE . . . and you pay more for less training than you get *in our course* at ONE LOW TUITION!

These two FREE books will show you how!

You get all information by mail . . . You make your own decision . . . at home! NO SALESMAN WILL CALL

TOP PAY...UNLIMITED OPPORTUNITIES LIFETIME SECURITY CAN BE YOURS!

You are needed in the Television, Radio, and Electronics industry! Trained technicians are in growing demand at excellent pay— in ALL PHASES, including Servicing, Manufacturing, Broadcasting and Communications, Automation, Radar, Government Missile Projects.

NATIONAL SCHOOLS SHOP-METHOD HOME TRAINING, with newly added lessons and equipment, trains you in your spare time at home, for these unlimited opportunities, including many technical jobs leading to supervisory positions.

YOU LEARN BY BUILDING EQUIPMENT WITH KITS AND PARTS WE SEND YOU. Your National Schools course includes thorough *Practical* training—YOU LEARN BY DOING! We send you complete standard equipment of professional quality for building various experimental and test units. You advance step by step, perform more than 100 experiments, and you build a complete TV set from the ground up, that is yours to keep! A big, new TV picture tube is included at no extra charge.

EARN AS YOU LEARN. We'll show you how to earn extra money right from the start. Many of our students pay for their course—and more—while studying. So can you!

LESSONS AND INSTRUCTION MATERIAL ARE UP-TO-DATE, PRACTICAL, INTERESTING. Every National Schools Shop-Method lesson is made easy to understand by numerous illustrations and diagrams. All instruction material has been developed and tested in our own Resident School Shops, Laboratories and Studios.

SEND FOR INFORMATION TODAY . . . it can mean the difference between SUCCESS and failure for you! Send for your FREE BOOK "Your Future in Television-Radio-Electronics" and FREE Sample Lesson. Do it TODAY, while you are thinking about your future. It doesn't cost you anything to investigate!

YOU GET...

- 19 Big Kits—YOURS TO KEEP!
- Friendly Instruction and Guidance
- Job Placement Service
- Unlimited Consultation
- Diploma—Recognized by Industry
- EVERYTHING YOU NEED FOR SUCCESS!

SHOP-METHOD HOME TRAINING COVERS ALL PHASES OF INDUSTRY

1. Television, including Color TV
2. Radio AM & FM
3. Electronics for Guided Missiles
4. Sound Recording and Hi-Fidelity
5. FCC License
6. Automation and Computers
7. Radar & Micro-Waves
8. Broadcasting and Communications

GET THE BENEFITS OF OUR OVER 50 YEARS EXPERIENCE

Approved for GI Training

MEMBER

NATIONAL SCHOOLS
Los Angeles 37, Calif.

RESIDENT TRAINING AT LOS ANGELES

If you wish to take your training in our Resident School at Los Angeles, the world's TV capital, start NOW in our big, modern Shops, Labs and Radio-TV Studios. Here you work with latest Electronic equipment - - professionally installed - - finest, most complete facilities offered by any school. Expert, friendly instructors. Personal attention. Graduate Employment Service. Help in finding home near school - - and part time job while you learn. Check box in coupon for full information.

NATIONAL TECHNICAL SCHOOLS
WORLD-WIDE TRAINING SINCE 1905

MAIL NOW TO
NATIONAL SCHOOLS, Dept RG-10
4000 S. FIGUEROA ST. LOS ANGELES 37, CALIF.

Rush free TV-Radio "Opportunity" Book and sample lesson. No salesman will call.

NAME _____ AGE _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

☐ Check if interested ONLY in Resident School training at Los Angeles.

VETERANS: Give date of Discharge _____

News Briefs

FM KEEPS GROWING after slump several years back threatened its very existence. Growth is shown by increased sales of FM–AM sets, more FM-only models, and more stations authorized and on the air. (See also page 8, October, 1959.)

Of the 8,500,000 radios sold in 1957 only about 2% included FM. In 1958, the percentage was up half again to 3% of total radio sales, and last year's sales of FM and FM–AM radios was close to 5% of all sets sold. (These figures don't include hi-fi components.)

Zenith, who manufactured an FM-only set years ago, is again putting out such a receiver. Now Sylvania is introducing an FM-only set, and Granco Products has been making FM-only sets for about 3 years. Other big manufacturers are reported about to go into the market with similar table models for FM only.

Recent FCC figures indicate that FM stations on the air were up (as of October, 1959) to 646 over the 578 of Dec. 31, 1958. In addition, 157 more FM stations are authorized to go ahead with construction.

MARS NET SCHEDULE for January is set for Wednesdays, SSB, 9:00 pm EST on 4030 kc upper sideband: Jan. 6—"The Atomicron," Philip Heath; Jan. 13—"Antenna Multicouplers," Carl Southeimer; Jan 20—"TV and the Amateur Operator," G. G. Lentzakis; Jan. 27—"Reinforced Plastics in Communications Products," W. H. Greenberg and J. H. McCoy.

The First Army Military Affiliate Radio System (MARS Net) presents lectures with open discussion on 4030 kc following the talks every Wednesday except during the summer.

SALT WATER CUTS METALS better than more conventional tools, using a stream of brine around a copper bit to etch away super-hard jet-age metals. Developed by the Anocut Engineering Co. (Chicago), this process follows somewhat the same approach as the etching of surface-barrier transistors. The se-

Electronic Highlights of 1959

AS advertised in advance, 1959 became the biggest year yet, measured by numbers of new developments and inventions, and units of electronic gear manufactured and sold. It was a year that saw electronics guiding satellites and space probes around the earth, moon and sun, as well as sending back information from many of these vehicles. (The US launched 9 of the 12 successful space travelers during the first 11 months.) There were numerous interesting new applications of electronics to medical ends: controlling heartbeats, improving artificial larynxes, providing proton-beam brain scalpel, to mention three.

Ultrasonics (and sonics) kept spreading, new uses ranging from measuring the thickness of meat on cattle to controlling the combustion rate of rocket fuel.

As the sky filled nearer to capacity with ever-faster aircraft our industry developed more complex and better radar and communications techniques to keep pace.

There was continuing development of long-range propagation techniques, at ever-higher frequencies aided by better masers and paramps. As always, the emphasis was on preparation of warlike devices (for example, long-range missile detection), pointing to vastly improved products for peacetime communications for commerce, education and entertainment.

While the first short TV movie was sent over the new trans-Atlantic cable via slow-scan facsimile, a first step toward overseas TV, over 20 countries were linked here, in Europe, Africa and Asia via cables and microwaves for 3 hours of high-quality radio broadcasts on United Nations Day. And the Post Office made a large appropriation to research facsimile transmission of letters coast to coast.

This was the year which saw more Japanese semiconductors, tiny transistor radios, vacuum tubes and other components imported than in all previous years combined.

High fidelity marched ahead, too, however uncertain some of the steps seemed. Although 16 2/3-rpm discs still existed primarily for Braille Talking Books, highway hi-fi got set to try again—RCA put standard 45-rpm records in new DeSotos and Plymouths. Stereo discs and playback systems became commonplace (and fashionable). The tape cartridge was reintroduced; this time machines to play it were actually in the stores. Meanwhile, most of the magnetic recording industry got together, bringing out quantities of reel-to-reel four-track tape at 7½ inches per second. And every recorder maker brought out a stereo machine, many of them stereo recorders. More stereo broadcasts than ever before went onto regular weekly schedules over numerous stations, while the stereo multiplex situation remained unresolved, though progress was made. Music lovers were gladdened by a magic ingredient RCA put into its discs to kill snap, crackle and pop due to static attraction of dust to the grooves.

Electricity was generated directly from gas by four teams here and in England. One model powered a 3,000-pound electric tractor on propane.

The unfinished dream of Tesla, sending power by radio waves, took a large step toward practical achievement as Raytheon brought out the Amplitron, a high-power tube with high conversion efficiency and improved heat dissipation, which promised to take raw ac and beam many watts miles overhead to sky stations.

The year 1959 saw the 25th anniversary of the FCC with almost 5,000 commercial broadcast stations, over 200,000,000 receiving sets, more than 1,500,000 mobile and portable communications stations, and over 185,000 radio amateurs licensed. By year's end there were probably more than 50,000 Citizens band radio users, and scores of thousands more were expected shortly.

Jan. 20
Cold-cathode tube eliminates heater, points to much greater tube reliability; Tung-Sol and Signal Corps. *(March, p. 6; April, p. 98)*

Feb. 17
Vanguard II, first weather-reporting satellite, launched.

March 5
Sylvania, General Telephone merge into General Telephone & Electronics Corp.

March 11
Nuvistor, very small rugged vacuum tube. High reliability, extremely long life. Production predicted for 1960 by developer, RCA. *(May, p. 6; June, p. 40)*

March 19
Radar contact with Venus verified. *(May, p. 47)*

March 23
Field-effect tetrode. Semiconductor can be transformer, isolator, stable short-circuit resistance and operate in other complex ways previously impossible without extensive circuitry. *(June, p. 16)*

May 25
First truly portable TV set uses transistors. Philco. *(June, p. 10; July, p. 56; August, p. 46)*

May 28
G-E announces fuel cell using hydrogen and oxygen combining directly to generate dc at 60% thermal efficiency. *(August, p. 6; November, p. 6; December, p. 16)*

July 20
Tunnel diode shown here by G-E. Oscillates and amplifies at frequencies possibly up to 10,000 mc. Very low noise, extremely low power required. Invented in Japan by Esaki in 1958. *(September, p. 6)*

Aug. 7
Explorer VI, "paddle-wheel," launched. Extensive instrumentation employing solar cells. Crude picture of clouds sent back. *(October, p. 10)*

Aug. 17
ITU (International Telecommunications Union) starts once-every-10-years meeting in Geneva to consider 5,000 proposals, mostly frequency allocations. *(November, p. 6; December, p. 12)*

Aug. 18
Avalanche diode (compensated), three-layer silicon device with low dynamic resistance, low noise and low temperature coefficient announced by Shockley Transistor Div., Beckman Instruments.

Aug. 24
Phonograph for autos using standard 45-rpm discs introduced by Plymouth, DeSoto, RCA for 1960 cars.

Sept. 22
Second Atlantic Cable opened for service, connecting phone networks of US and western Europe. *(November, p. 6)*

Oct. 2
Lunik III orbits moon, taking crude pictures of unseen side, transmitting pictures to earth.

Oct. 27
G-E announces electricity made directly from hot gas. Efficiency of engine reported 50%, 90% ultimately possible.

MEN 17-55 GET FREE FACTS

Let DeVRY Tech prepare you in spare time to be an

Electronics Technician

WORK OVER 300 PRACTICAL PROJECTS AT HOME WITH THESE PARTS

Train for a Good-Paying Job or your own Business in One or More Branches of Electronics!

Radar • Communications • Radio • Television
Hi-Fi Stereo Sound • Computers • Broadcasting
Your Own Service Shop • Guided Missile Control
Industrial and Automation Electronics

It's a fact! In almost any location where good Television-Radio-Electronics technicians are found, you'll see DeVry-trained men earning GOOD PAY . . . holding EXCITING JOBS . . . facing a REAL FUTURE. Many DeVry-trained men have good jobs in modern plants, broadcast studios, laboratories, to name a few; others have profitable service shops of their own.

What's so important, many of these now-skilled men had NO PREVIOUS TECHNICAL EXPERIENCE OR ADVANCED EDUCATION when they first contacted DeVry Tech. At home in their spare time, they learned basic principles using clearly-written texts and MOTION PICTURE TRAINING FILMS. They developed practical skill working with many shipments of Electronic parts . . . and soon became technicians the proved DeVry way. What these men have done, YOU should be able to do, too. NOW is the time to act, for the Electronics field is growing steadily larger. This means wonderful opportunities ahead for those who start preparing now. Take that all-important first step by mailing the coupon below.

PREPARE IN CHICAGO OR TORONTO TRAINING CENTERS

DeVry's great training centers at Chicago and Toronto also are noted for preparing men thoroughly. Students learn quickly—using much actual Electronic equipment under the guidance of friendly, experienced instructors.

HOME MOVIES MAKE "HIDDEN ACTIONS" CRYSTAL CLEAR

On the wall of your own room, you see radio waves travel through the air . . . circuits "come alive" . . . hidden actions shown . . . through the magic of DeVry's home training movies. What a wonderful aid to your progress!

EFFECTIVE EMPLOYMENT SERVICE HELPS YOU START

DeVry's long-established contacts with employers of trained technicians can be valuable to YOU when you are one of our graduates. And we'll also show you how to start your own profitable Television-Radio servicing business, if that's your aim.

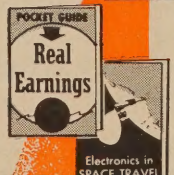
Draft Age?

DeVry has important information for men who face military service. Ask for details.

SEND THIS COUPON TODAY!

2 FREE Booklets. Act Now!

"One of North America's Foremost Electronics Training Centers"



DEVRY TECHNICAL INSTITUTE
4141 Belmont Avenue • Chicago 41, Illinois
Accredited Member of National Home Study Council

You Build This 5-Inch Color OSCILLOSCOPE

After working scores of practical projects, you build and keep this 5-inch wide band Oscilloscope—a "must" for profitable servicing.

Also Build This Quality VACUUM TUBE VOLTMETER

Another valuable test instrument which you build and keep. Helps you earn spare time income while you learn.

2 Practical Projects

1. 21-INCH TV SET, complete with instructions and all parts, including picture tube. Tops for instructional value!
2. HI-FI STEREO SOUND SYSTEM. Bring "3-D" sound into your home and learn important principles as well, when you build this DeVry-quality system.

DeVRY TECHNICAL INSTITUTE, Dept. RE-1-Q
4141 Belmont Avenue, Chicago 41, Ill.

Please give me your two free booklets, "Pocket Guide to Real Earnings," and "Electronics in Space Travel;" also include details on how to prepare for a career in one or more branches of Electronics.

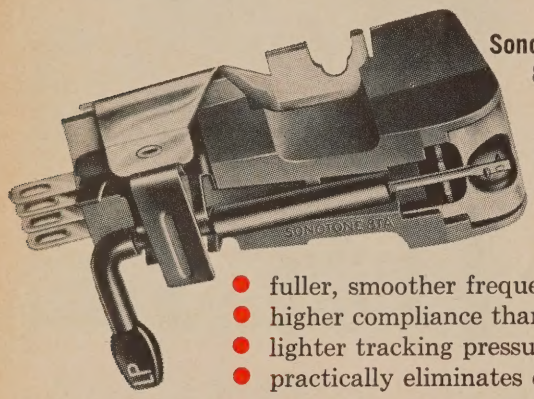
Name _____ Age____
Please Print
Street _____ Apt.____
City_____ Zone____ State_____
☐ Check here if you face military service.
Canadian residents write DeVry Tech of Canada, Ltd., 626 Roselawn Ave., Toronto 12, Ont.

2068

Now...from Sonotone—

4 Big Improvements

in the quality stereo cartridge



Sonotone 8TA cartridge replaces 8T as industry standard

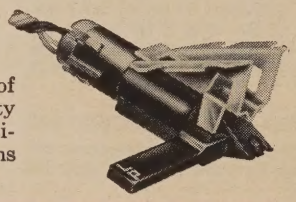
The new Sonotone 8TA cartridge gives greater than ever stereo performance... has 4 big extras:

- fuller, smoother frequency response
- higher compliance than ever before
- lighter tracking pressure
- practically eliminates dust pile-up

ONLY $14.50*

Sonotone 10T unitized stereo at lowest price ever

New 10T cartridge sells at record low price of $6.45.* And it covers the complete high fidelity range. 10T's unitized construction makes it easiest to install, easiest to replace. Low price means more sales—more profits.



SPECIFICATIONS

	8TA	10T
Frequency Response	Smooth 20 to 20,000 cycles. Flat to 15,000 with gradual rolloff beyond.	Flat from 20 to 15,000 cycles ± 2.5 db.
Channel Isolation	25 decibels	18 decibels
Compliance	3.0 x 10^{-6} cm/dyne	1.5 x 10^{-6} cm/dyne
Tracking Pressure	3-5 grams in professional arms 4-6 grams in changers	5-7 grams
Output Voltage	0.3 volt	0.5 volt
Cartridge Weight	7.5 grams	2.8 grams
Recommended Load	1-5 megohms	1-5 megohms
Stylus	Dual jewel tips, sapphire or diamond.	Dual jewel tips, sapphire or diamond.

*including mounting brackets

Sonotone makes only 6 basic ceramic cartridge models... yet has sold over 9 million units...used in over 662 different phonograph models. For finest performance, replace worn needles with genuine Sonotone needles.

Sonotone® CORP. Electronic Applications Division, Dept. C2-10 **ELMSFORD, NEW YORK**

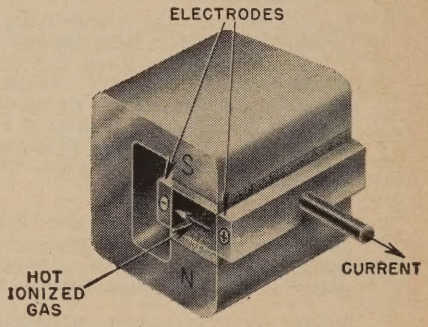
Leading makers of fine ceramic cartridges, speakers, tape heads, microphones, electronic tubes.
In Canada, contact Atlas Radio Corp., Ltd., Toronto

cret is in the use of direct current with the brine to etch the metal in a sort of reverse of electroplating. Besides providing greater speed than ordinary methods, the Anocut process preserves the bit's cutting edge.

MICROWAVE LINK TO ALASKA will run 1,250 miles across Canada, using 50 towers spaced an average of 25 miles apart. The system will have two broadband links, one a standby, each capable of carrying up to 120 telephone or telegraph channels, or even a TV program.

The United States plans to lease one link for 10–15 years, thus financing the job, estimated at about $20,000,000. RCA-Victor Ltd. of Montreal will build the system for Canadian National Telegraphs.

MAGNETOHYDRODYNAMIC generation of power (MHD) is the name given by General Electric scientists to a new way of producing electricity direct from heated gas. The method is based on the movement of an electrical conductor through a magnetic field. In this case, the conductor is a plasma of heated air or other gas. As the drawing shows, the hot ionized gas, which is a conductor, is directed through the magnetic



field. The effect is the same as if an infinite number of copper wires, with their ends contacting the front and rear electrodes, were pushed through the space between the magnets. Current is taken from the electrodes.

In tests, a single unit produced—for a short time—900 watts at approximately 30 volts, with an efficiency of 50%. This is already more efficient than the best steam units, and theoretically much higher efficiencies are possible. The unit is essentially a homopolar generator, and produces direct current.

MHD power generation could be utilized in a space vehicle in either a closed cycle for continuous power or an open cycle for short bursts of power. In the closed-cycle system, solar energy or a nuclear reaction would be used as the heat source and the gaseous conductor would be continually recirculated. The open cycle could use a small solid-fueled rocket motor for a heat source. Rocket motors now exist to provide from 1 to 3 second's operation, sufficient, for example, to provide the high power necessary to transmit a television image from a space vehicle on the moon.

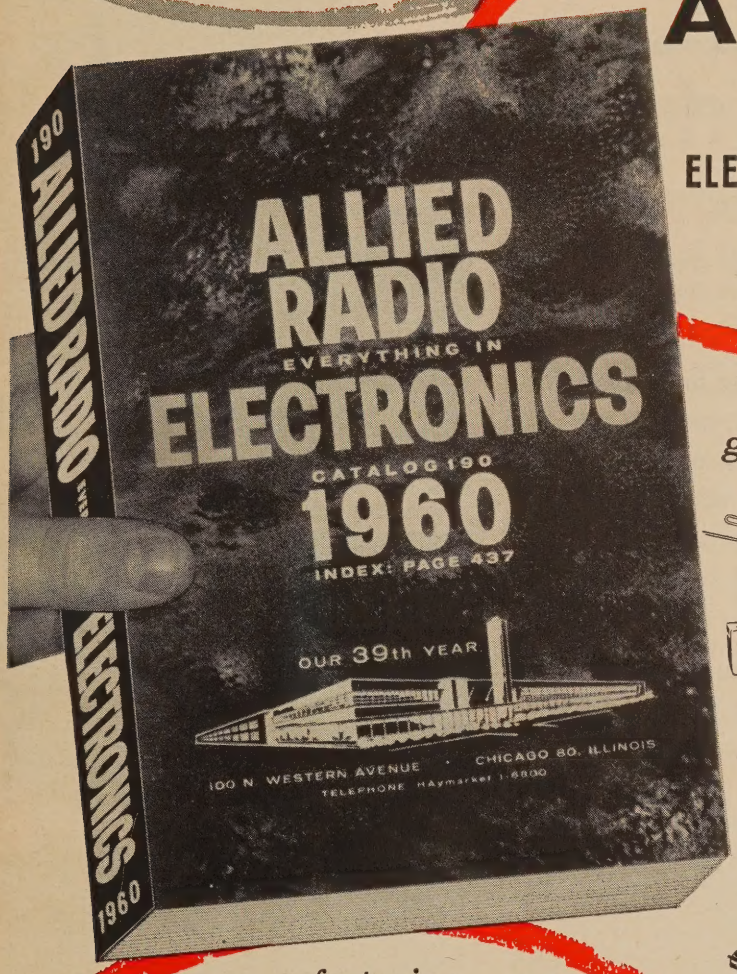
(*Continued on page* 14)

FREE

ALLIED'S 1960

ELECTRONIC SUPPLY CATALOG

it's value-packed... send for it!



your complete money-saving guide to everything in electronics

WORLD'S LARGEST STOCKS

- Latest Stereo Hi-Fi Systems—Everything in Hi-Fi Components
- Money-Saving, Build-Your-Own KNIGHT-KITS for Every Need
- Values in Recorders and Supplies
- Latest Public Address Systems, Paging and Intercom Equipment
- Amateur Receivers, Transmitters and Station Gear
- Test and Laboratory Instruments
- TV Tubes, Antennas, Accessories
- Huge Listings of Parts, Tubes, Transistors, Tools, Books

NEW LOW EASY PAY TERMS

Only $5 down (or less) on orders up to $200. Up to 24 months to pay. Fast handling—no red tape.

featuring these **ALLIED** *exclusives:*

MONEY-SAVING KNIGHT-KITS®—the very best in build-your-own electronic equipment—designed to save you up to 50%. "Convenience Engineered" for easiest assembly; the only kits covered by Money-Back Guarantee. Complete selection of Stereo hi-fi kits, Hobbyist kits, Test Instrument and Amateur kits. KNIGHT-KITS are an exclusive ALLIED product.

KNIGHT® STEREO HI-FI—truly "honored for value"—the best you can buy, yet far lower in cost. Select super-value KNIGHT components or complete systems and save most. Also see the world's largest selection of famous name hi-fi components and money-saving ALLIED-recommended complete systems.

Get every buying advantage at ALLIED: lowest money-saving prices, fastest shipment, expert personal help, guaranteed satisfaction...

send for the leading electronic supply guide **FREE**

ALLIED RADIO CORP., Dept. 2-A
100 N. Western Ave., Chicago 80, Ill.

☐ Send FREE 1960 ALLIED Catalog.

*Name*_____

*Address*_____

*City*_____ *Zone*_____ *State*_____

ALLIED RADIO

our 39th year

World's Largest Electronic Supply House

ELECTRONIC TECHNICIANS...

Add a quick source of extra profits with free training in servicing the

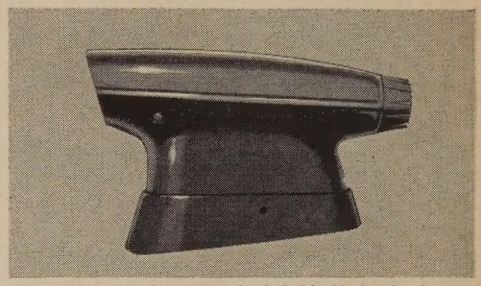
GUIDE-MATIC

POWER HEADLIGHT CONTROL

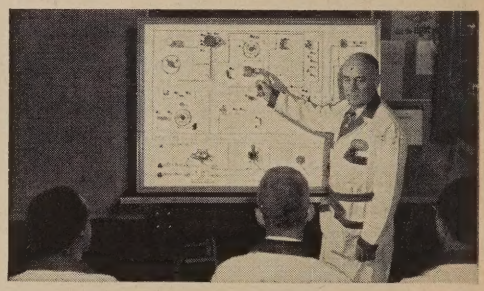
Simple when you know how it works, Guide-Matic could be your fastest growing source of new business for years to come. And it only takes one day of factory-style training to learn the skills of fast, accurate trouble-shooting and quick service to factory specifications.

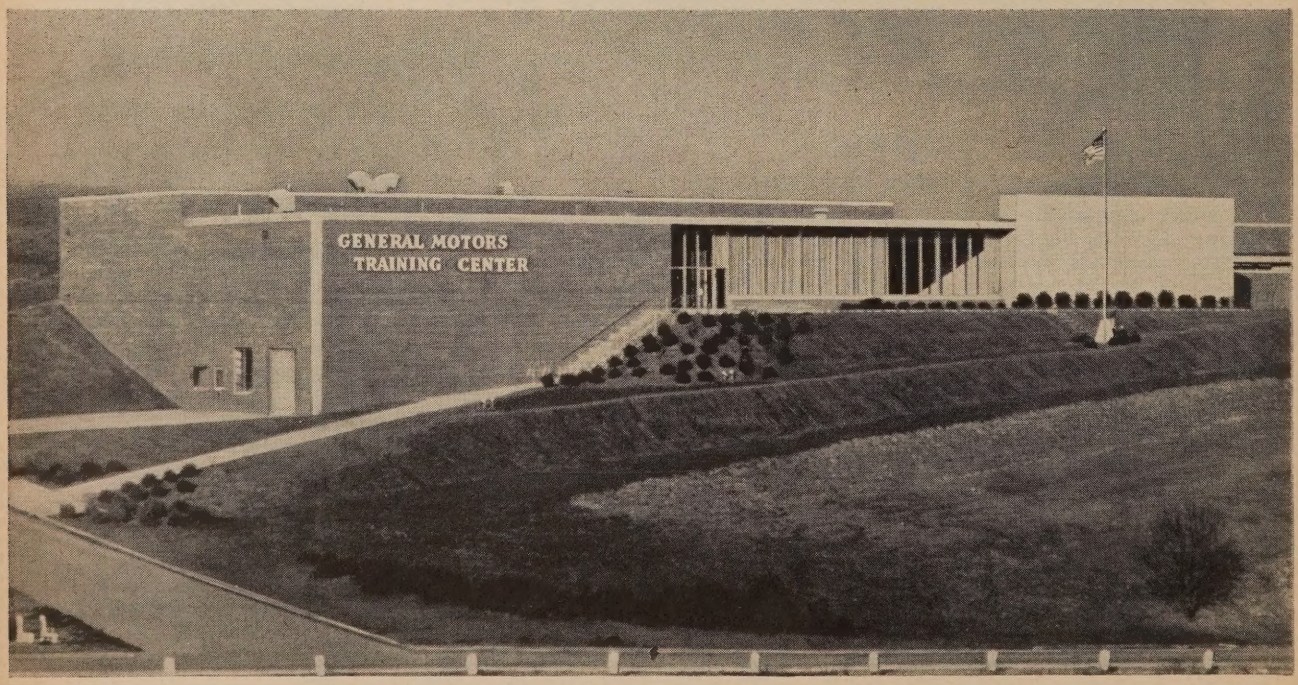
The course itself won't cost you a cent . . . it's free to qualified electronic technicians. Your only outlay is for transportation and the usual living expenses. It's worth it to have a Guide Lamp diploma proving that you're fully equipped to give fast, efficient service to all the Guide-Matic and Autronic-Eye owners in your area. As an added feature, twilight Sentinel automatic light switch training is also included.

If you are in the electronics service business, come yourself, or send your technicians. There is one of 30 GM Training Centers near you. Apply through your local United Motors Service Division Distributor or write Guide Lamp Division, General Motors Corp., Anderson, Indiana.



Jumbo-size operational panel of Guide-Matic circuit puts all parts out front for better, more efficient instruction.

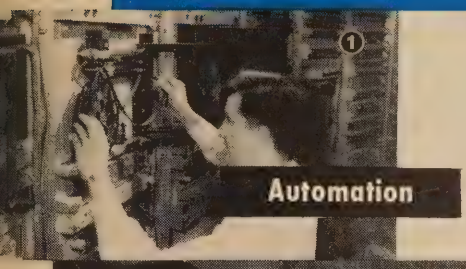


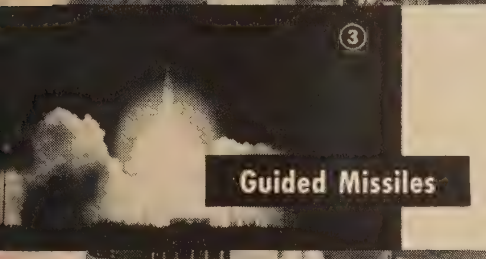


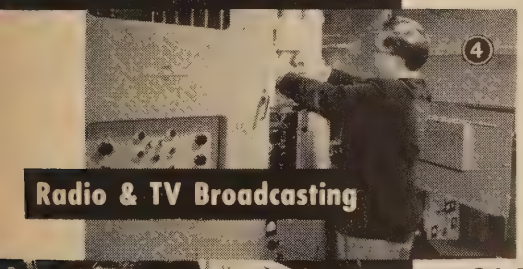
GUIDE LAMP DIVISION

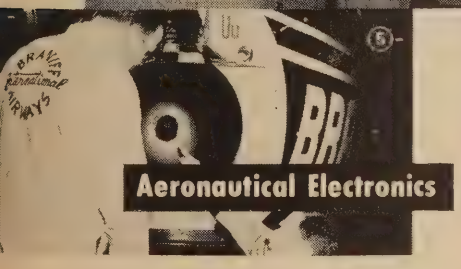
GENERAL MOTORS CORP.
ANDERSON, INDIANA

How to Get a Commercial FCC License









do you know what an FCC license really can do for you in Electronics?

1 More income for you every week

2 A more interesting job in electronics

The average person spends over 50% of his waking hours on the job (or going to and from the job). Therefore doesn't it make sense to have a job that is really interesting and also pays well?

The chances are very good that if you are reading this magazine you can qualify for the really good jobs in electronics like those shown in the pictures at the left . . . and it won't take long to do it. Your past training and experience in basic electronics (such as radio and TV repair, armed forces electronics, ham operators, etc.) can be the foundation for a profitable career as an "across-the-board" electronics technician.

Whether you run your own shop or work for someone else, the real money, the interesting work, is available to the man who can effectively handle the more complex electronic gear. Home receiver repair can provide a good living, but it can't match the opportunities open to a skilled electronics technician.

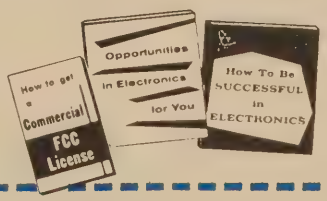
The Career Information Material shown below will show you how you can qualify for a government certificate of competency . . . a commercial FCC License . . . and acquire a really fine technical education. Find out how your success with the FCC examination is guaranteed . . . or your money back.

You will also find out which jobs require the FCC License . . .where technicians are needed . . . what a technician needs to know about electronics . . . and many other facts about opportunities for you in electronics.

It will cost you only the price of a postage stamp to get all the facts. If you are in any type of electronics work . . . or if you have had previous training or experience in electronics . . . you owe it to yourself to ask us to send you information on profitable careers in electronics.

CLEVELAND INSTITUTE OF ELECTRONICS
Desk RE-37A, 4900 Euclid Ave. Cleveland 3, Ohio

1. Raytheon Manufacturing Company
2. Radio Corporation of America
3. Jupiter IRBM, Army Ordnance Missile Command
4. Collins Radio Company
5. Radio Corporation of America



free!

FIND OUT HOW:

- **The new electronic devices can be handled by you**
- **To solve the problems that will stump your fellow technicians**
- **Training is Job Insurance when employment is tough to find . . . and more money for you when times are good**

CLEVELAND INSTITUTE OF ELECTRONICS
Desk RE-37A, 4900 Euclid Ave., Cleveland 3, Ohio

Please send FREE Career Information Material prepared to help me get ahead in Electronics. I have had training or experience in Electronics as indicated below:

- ☐ Military
- ☐ Radio-TV Servicing
- ☐ Manufacturing
- ☐ Amateur Radio
- ☐ Broadcasting
- ☐ Home Experimenting
- ☐ Telephone Company
- ☐ Other

In what kind of work are you now engaged? _____

In what branch of Electronics are you interested? _____

Name _____ Age _____

Address _____

City _____ Zone ____ State _____

RE-37A

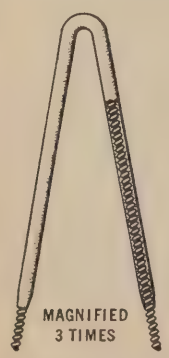
Hey... I've got new coil heaters!

(GOODBYE TO YOUR FRONT-END TROUBLES)

"All 6BQ7A's used to have folded heaters . . . and gave you plenty of trouble. Now, all of us CBS 6BQ7A tubes have new coil heaters for our new improved cathodes . . . and *you* don't have heater burnouts, shorts or slumping gain."

Yes, the new CBS 6BQ7A offers you *total reliability* . . . proved in performance by leading TV and radio set manufacturers. You, too, can profit from the *total reliability* of CBS tubes. Prove it to yourself. Replace with CBS.

TOTAL RELIABILITY...proved in performance



Old-style 6BQ7A folded heaters had seven folds . . . each fold a potential source of burnouts and shorts. The new CBS 6BQ7A heaters, because of the telescopic effect of coiling the heater, have only one gradually curved fold. The result is that CBS 6BQ7A's just don't develop those irritating, costly shorts and opens.

Receiving, industrial and picture tubes • transistors and diodes • audio components • and phonographs

CBS ELECTRONICS
Danvers, Massachusetts
A Division of Columbia Broadcasting System, Inc.

1. Also: Let It Rain, Stairway to the Sea, Flame of Love, etc.

5. A Night on Bald Mountain, Steppes of Central Asia, etc.

6. Bess, You Is My Woman Now; It Ain't Necessarily So; etc.

17. Over the Rainbow, Night and Day, Easy to Love, 9 more

34. ". . . the music is all extraordinary" —Boston Daily Record

33. This brilliant musical painting is an American classic

10. A brilliant new performance of this popular concerto

13. But Not for Me, Fascinatin' Rhythm, Man I Love, 9 more

2. 1001 hi-fi delights. "...top-notch sound" — Billboard

9. Sweet Adeline, For Me and My Gal, Pretty Baby, 13 more

15. An exciting array of 16 classical and popular selections

18. Rain in Spain, I Could Have Danced All Night, etc.

COLUMBIA (Lp) RECORD CLUB offers new members
ANY SIX
of these 12" long-playing STEREO records
FOR ONLY $4.98
Retail Value up to $35.88
if you join the Club now and agree to purchase as few as 5 selections
from the more than 150 to be made available during the coming 12 months

11. Also: Blessed Are They That Mourn, Come Ye Saints, etc.

24. "Musical excitement that's hard to beat" — Variety

56. Serenade in Blue, Willow Weep for Me, 9 others

3. Stella by Starlight, Pacific Sunset, Yesterdays, 9 others

25. Superbly played by one of Europe's finest orchestras

40. I Miss You So, Speak Low, Time After Time, 9 more

36. A musical landscape . . . "spacious, noble"—High Fidelity

26. Blue Moon, Fools Rush In, Don't Worry 'bout Me, 9 more

47. Solitude, Where or When, Dancing in the Dark, 5 more

49. One of the most melodically beautiful of all symphonies

30. Alexander's Ragtime Band, Cheek to Cheek, Always, etc.

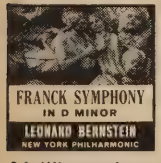
19. Tales from the Vienna Woods, Blue Danube, 8 others

12. Londonderry Air, Shenandoah, 11 more folksong favorites

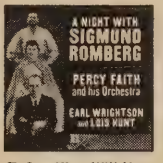
22. "Enormous talent and technique" — Chicago News

4. Wild Man Blues, Fine and Mellow, I Left My Baby, 5 more

37. "Most exciting recording of this work"—Time



14. "No symphony like it . . . incomparable" — Olin Downes



7. One Kiss, Will You Remember, Song of Love, 9 more

29. Three of the Master's favorite chamber works

31. You've Changed, Body and Soul, I Got It Bad, 9 others

35. "One of the great, great albums" — San Francisco Examiner

50. Come to Me, That Old Feeling, Long Ago, 9 more

8. "Beautiful...lingering brilliance" — Chicago Tribune

39. Tico-Tico, My Shawl, Besame Mucho, 9 others

AN EXCITING NEW OFFER FROM THE WORLD'S LARGEST RECORD CLUB

If you now own a stereo phonograph, or plan to purchase one in the near future—here is a unique opportunity to obtain ANY SIX of these brand-new stereo records for only $4.98!

TO RECEIVE 6 STEREO RECORDS FOR $4.98 — fill in and mail the coupon now. Be sure to indicate which one of the Club's two musical Divisions you wish to join: Stereo Classical or Stereo Popular.

HOW THE CLUB OPERATES: Each month the Club's staff of music experts selects outstanding recordings from every field of music. These selections are described in the Club's entertaining Music Magazine, which you receive free each month.

You may accept the monthly selection for your Division, take any other records offered (classical or popular), or take NO record in any particular month.

Your only obligation as a member is to purchase five selections from the more than 150 Columbia and Epic records to be offered in the coming 12 months . . . and you may discontinue your membership at any time thereafter.

FREE BONUS RECORDS GIVEN REGULARLY: If you wish to continue as a member after purchasing five records, you will receive a Columbia or Epic stereo Bonus record of your choice free for every two selections you buy — a 50% dividend.

The records you want are mailed and billed to you at the regular list price of $4.98 (Classical and Original Cast selections, $5.98), plus a small mailing and handling charge.

MAIL THE COUPON TODAY!

NOTE: Stereo records must be played only on a stereo phonograph

COLUMBIA (Lp) RECORD CLUB Terre Haute, Indiana

SEND NO MONEY — Mail coupon to receive 6 stereo records for $4.98

COLUMBIA (Lp) RECORD CLUB, Dept. 202-6
Stereophonic Section, Terre Haute, Indiana

I accept your offer and have circled at the right the numbers of the six records I wish to receive for $4.98, plus small mailing and handling charge. Enroll me in the following Division of the Club:

(check one box only)

☐ **Stereo Classical** ☐ **Stereo Popular**

I agree to purchase five selections from the more than 150 records to be offered during the coming 12 months, at regular list price plus small mailing and handling charge. For every two *additional* selections I accept, I am to receive a 12" Columbia or Epic stereo Bonus record of my choice FREE.

Name.....
(Please Print)

Address.....

City.....ZONE....State.....

ALASKA and HAWAII: write for special membership plan
CANADA: address 1111 Leslie St., Don Mills, Ontario

If you want this membership credited to an established Columbia or Epic record dealer, authorized to accept subscriptions, fill in below:

Dealer's Name.....

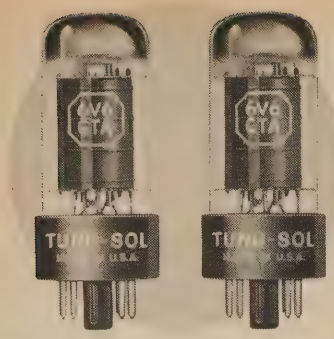
Dealer's Address.....21

CIRCLE 6 NUMBERS:

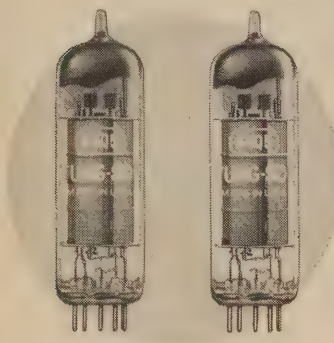
1	13	31
2	14	33
3	15	34
4	17	35
5	18	36
6	19	37
7	22	39
8	24	40
9	25	47
10	26	49
11	29	50
12	30	56

P-BC

® "Columbia," (Lp), "Epic," ® Marcas Reg. © Columbia Records Sales Corp., 1960



6V6GTA Bantam beam power amplifier with high power sensitivity and high power output with low supply voltages. Two in push-pull up to 14 watts.



6BQ5 Nine pin miniature power for low power requirements. Two in push-pull deliver up to 17 watts.

Tung-Sol announces two new additions to line of matched pairs

Now Tung-Sol is packing more of their quality audio-hi-fidelity-stereo power tube line in dynamically-balanced pairs. The same kind of precision balance and premium power delivery you've been getting from factory-matched pairs of 5881's and 6550's is also available from two more twin-packed tubes in Tung-Sol's growing selection of dynamically-matched audio tubes—electrically balanced 6V6GTA's and 6BQ5's.

With these twin-packed additions Tung-Sol now fills all of your premium audio requirements up to 100 watts while maintaining an exact and reliable current balance between tubes. And with each of these premium push-pull audio drives you not only eliminate the need for bias compensating circuitry but you also benefit from the finest in sound reproduction.

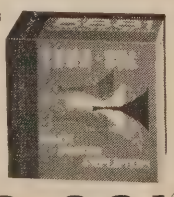
And remember, for commercial sound equipment or for the finest entertainment devices, Tung-Sol tubes provide an ideal combination of the most sought-after characteristics.

Tung-Sol Electric Inc., Newark 4, N. J.

Also available in matched pairs

5881 Beam power amplifier. Up to 50 watts.

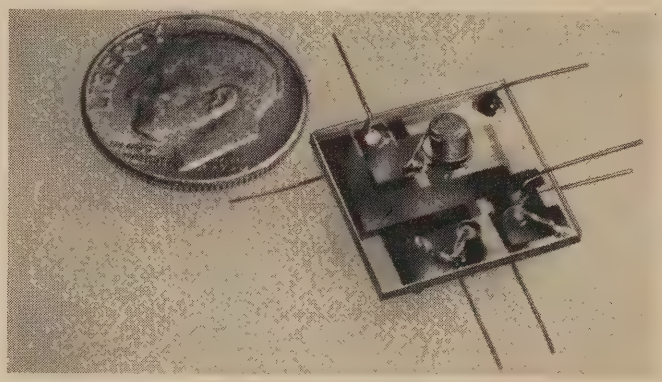
6550 Beam power amplifier. Up to 100 watts.



TUNG-SOL

The closed-system generation could be used on long space flights for such things as radio communication, light, heat, air conditioning and electrical propulsion. While MHD power generation may some day be applicable to other areas than space vehicle power—internal-combusion engine exhausts could be used after a certain amount of superheating—the technique will require considerable development and time before it may be used for stationary power generation.

MINIATURIZATION down to the molecular level has been achieved by research workers of the International Resistance Co. Going one step beyond the "printed" or engraved circuit, its elements are evaporated onto the board—



called a "substrate"—in layers which can be reduced to a few molecules thick.

The glass substrate is drilled to provide holes for diodes and transistors, cleaned thoroughly by chemical or ultrasonic means and placed in a vacuum, where what IRC research scientists call a "relatively thick" (2,000 to 5,000 Angstrom units) conducting layer is deposited on it. A mask confines the deposit to desired areas.

A second mask is placed on the substrate, and another layer—this time a dielectric layer—is evaporated onto the surface. A third step deposits the resistors, and a final one puts on the "top plates" of capacitors. Of course, the unit has to be taken out of the vacuum chamber between each step, for fitting the masks. After all the evaporation–deposition operations, the active elements (transistors, etc.) are soldered into place and input and output leads connected.

It has been possible to deposit resistances with values up to 100,000 ohms, capacitances up to 1 μf per square inch and inductors up to 1 μh in .05 square inch.

A technique similar in some ways was recently developed by Bell Labs (October, 1959, page 6).

3 NEW TV STATIONS are programming:

KLYD-TV, Bakersfield, Calif.....17
KNDO-TV, Yakima, Wash.....23
WABG-TV, Greenwood, Miss..... 6

Two returnees have reactivated:

WFAM-TV, Lafayette, Ind.....18
WICC-TV, Bridgeport, Conn.....43

WFAM-TV, off the air for 6 months, resumed under new ownership and on a new channel. WICC-TV, which had closed down Aug. 12, 1959, for a month, didn't reopen until Nov. 7, 1959.

Two stations left the network, however:

KHTV, Portland, Ore.....27
WTOV-TV, Norfolk, Va.....27

WTOV-TV quit per agreement to merge with WVBC - TV, Hampton - Norfolk, Va., channel 13. Note that WVBC-TV changed over from channel 15. Also, KCCC-TV, Sacramento, Calif., channel 40, has a new call, KVUE.

Canada has upped its total by two:

CJCB-TV-1, Inverness, N.S.....6
CJSS-TV, Cornwall, Ont.....8

CJCB-TV-1 is a satellite of CJCB-TV, Sydney, N.S., channel 4.

The US roundup of operating stations is now 565, including 473 vhf and 92 uhf. The noncommercial figure of 43 remains the same. Canada's total has moved up to 58.

MACHINE READS 10 handwritten words, "zero" to "nine," as a first step toward machines for scanning ordinary handwriting. Words must be written on special surface. Believed to be the first machine ever built which will read handwritten script, it was developed by Leon Harmon of Bell Labs.

The machine encourages good handwriting. Writers must dot their i's if they expect to be understood, for example. They may not print or lift the stylus between letters.

RADIOPHYSICS AND SPACE RESEARCH CENTER of Cornell University will have charge of the world's largest and most powerful radar, construction of which will start soon in Puerto Rico (page 12, December, 1959).

The 1,000-foot radar dish will have only limited motion of its beam—about 20° in each direction—because of its size. It will have a tripod mounted on the dish 600 feet high to support the feed antenna. The radar will pulse 2.5 million watts at about 420 mc into space.

Venus, Mars, Mercury and the sun will be contacted with this installation, and it is hoped that Jupiter, 400,000,000 miles away, will also be reached.

(*Continued on page* 18)

Learn Electronics

PREPARE FOR YOUR F. C. C. LICENSE—YOUR TICKET TO A BETTER JOB AND HIGHER PAY!

F.C.C. LICENSE—THE KEY TO BETTER JOBS

An F.C.C. *commercial* (not amateur) license is your ticket to higher pay and more interesting employment. This license is Federal Government evidence of your qualifications in electronics. Employers are eager to hire *licensed* technicians.

WHICH LICENSE FOR WHICH JOB?

The THIRD CLASS radiotelephone license is of value primarily in that it qualifies you to take the second class examination. The scope of authority covered by a third class license is extremely limited.

The SECOND CLASS radiotelephone license qualifies you to install, maintain and operate most all radiotelephone equipment except commercial broadcast station equipment.

The FIRST CLASS radiotelephone license qualifies you to install, maintain and operate every type of radiotelephone equipment (except amateur) including all radio and television stations in the United States, its territories and possessions. This is the highest class of radiotelephone license available.

GRANTHAM TRAINING PREPARES YOU

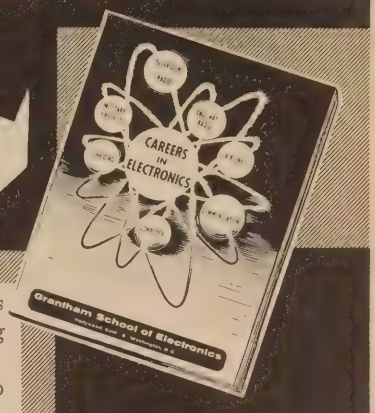
The Grantham Communications Electronics Course prepares you for a *FIRST CLASS* F.C.C. license, and it does this by TEACHING you electronics. Each point is covered simply and in detail, with emphasis on making the subject easy to understand. The organization of the subject matter is such that you progress, step-by-step, to your specific objective—a first class F.C.C. license.

CORRESPONDENCE OR RESIDENCE CLASSES

Grantham training is available by correspondence or in resident classes. Either way (residence or correspondence), we train you quickly and well—no previous training required. Even a beginner may qualify for his first class license in a relatively short time.

FOUR COMPLETE SCHOOLS: *To better serve our many students throughout the entire country, Grantham School of Electronics maintains four complete Divisions—located in Hollywood, Calif., Seattle, Wash., Kansas City, Mo., and Washington, D.C. All Divisions of Grantham School of Electronics offer the same rapid courses in F.C.C. license preparation, either by home study or in resident classes.*

This booklet **FREE!**



This free booklet gives details of our training and explains what an F.C.C. license can do for your future.

Upgrade Your Income with a First Class

F. C. C. LICENSE

HERE'S PROOF...

that Grantham students prepare for F.C.C. examinations in a minimum of time. Here is a list of a few of our recent graduates, the class of license they got, and how long it took them:

	License	Weeks
Mario Bidese, 342 Alexander Avenue, Greensburg, Pa.	1st	12
Richard M. Wilhoit, 2104 Santa Paula, Las Vegas, Nev.	1st	12
Larry R. Perrine, 7 Normandy Place, Champaign, Ill.	1st	15
Emerson F. Lawson, 111 Excelsior Ave., Union, S.C.	1st	12
Marion Woolsey, 3246 Warwick, Kansas City, Mo.	1st	12
Harold W. Johnson, 5070 Hermosa Ave., Los Angeles, Calif.	1st	15
Arthur W. Hardy, 66 Dresser Ave., Great Barrington, Mass.	1st	12
Ralph Frederick Beisner, 2126 Grand, Joplin, Mo.	1st	12
N. B. Mills, II, 110 So. Race St., Statesville, N.C.	1st	12
Dean A. Darling, 403 S. Chase Ave., Columbus 4, Ohio	1st	12
Paul D. Bernard, 408 First Ave., N.E., Watertown, S.D.	1st	18
Gerald L. Chopp, 518 Aubudon Road, Kohler, Wisc.	1st	12

GRANTHAM SCHOOL OF ELECTRONICS

HOLLYWOOD CALIF.	1505 N. Western Ave. Hollywood, Calif. (HO 7-7727)
SEATTLE WASH.	408 Marion Street Seattle, Wash. (MA 2-7227)
KANSAS CITY MO.	3123 Gillham Road Kansas City, Mo. (JE 1-6320)
WASHINGTON D. C.	821 - 19th Street, N. W. Washington, D. C. (ST 3-3614)

MAIL COUPON TO SCHOOL NEAREST YOU

(Mail in envelope or paste on postal card)

To: GRANTHAM SCHOOL OF ELECTRONICS

1505 N. Western Hollywood • 408 Marion Seattle • 3123 Gillham Rd. Kansas City • 821-19th, NW Washington

Gentlemen:

Please send me your free booklet telling how I can get my commercial F.C.C. license quickly. I understand there is no obligation and no salesman will call.

Name_____ Age ___

Address_____

City _____ State_____

I am interested in: ☐ Home Study, ☐ Resident Classes 04-A

DIFILM®

BLACK BEAUTY®
CAPACITORS
BEAT HEAT AND HUMIDITY

New DIFILM Black Beauty Capacitors lead the way in tubulars! The operating temperature range of these new capacitors goes up to 105 C (221 F) *without voltage derating.* Capacitance tolerance is held to ±10%.*

• The new dual dielectric used in DIFILM Capacitors combines the proven long life of paper capacitors with the effective moisture resistance of polyester plastic film capacitors . . . to give you performance that can't be beat.

• Here's the kind of performance you can expect from DIFILM: very high insulation resistance, low power factor, moderate capacitance change with temperature, excellent retrace under temperature cycling, and superior long-term stability . . . *all at regular prices!*

• This high performance is fully protected by HCX®, an exclusive Sprague hydrocarbon material which impregnates the windings, filling all voids and pinholes before it polymerizes. The result is a solid rock-hard capacitor section. These capacitors are further protected by an outer molding of humidity-resistant, non-flammable phenolic.

For complete technical information on DIFILM Black Beauty Capacitors, write for Bulletin M-759 to Sprague Products Company, 81 Marshall St., North Adams, Mass.

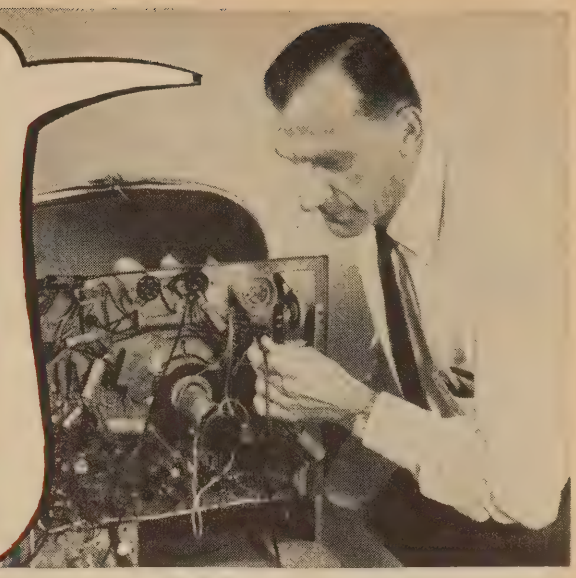
*From .001 μF up

The major capacitor improvements come from

SPRAGUE®
world's largest capacitor manufacturer

SPRAGUE RESEARCH IS CONSTANTLY PRODUCING NEW AND BETTER CAPACITORS FOR YOU

I chose COYNE TELEVISION RADIO-COLOR TV home training because Coyne has been training men for good jobs OR their OWN BUSINESS for NEARLY 60 YEARS



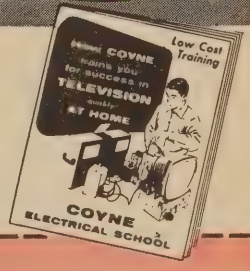
Giant opportunity field! Join the thousands Coyne Home Training is preparing for a successful future in TV—open the door to better pay jobs, *or* your own business! COYNE—a leading residential, practical school—oldest of its kind—established 1899—*is the institution behind this training.*

Here is **MODERN—QUALITY TELEVISION** Home Training designed to meet the rigid standards that have made Coyne famous. You get personal supervision of Coyne Staff who know TV and know how to teach. **Learn quickly and easily in spare time.** No previous experience or advanced education necessary.

I chose COYNE because their new method costs less than half what most others do!

SEND COUPON FOR FREE BOOK

Send coupon below for all-new fully-illustrated book and full details including **EASY PAYMENT PLAN. NO COST OR OBLIGATION—NO SALESMAN WILL CALL**



Modern, up-to-the-minute. Easy to follow, step-by-step instructions—fully illustrated with 2150 photos and diagrams. **UHF and COLOR-TV included.** So practical you can quickly earn extra money in TV-Radio Sales and Service. Not only Coyne Quality training, but costs *half* what you'd expect to pay because you pay only for training—no costly extras. Free life-time employment service.

B. W. Cooke, Jr.
President

COYNE ELECTRICAL SCHOOL Founded 1899

A TECHNICAL TRADE INSTITUTE OPERATED NOT FOR PROFIT
1501 West Congress Parkway, Dept. 10-H5, Chicago 7, Illinois

COYNE TELEVISION
HOME TRAINING DIVISION
1501 West Congress Parkway, Chicago 7, Illinois
Dept. 10-H5

Send FREE Book and details of your Television – Radio – Color TV Home Training offer.

*Name*_____

*Address*_____

*City*_____ *State*_____

How do you rope 5 watts of Power in a 2-watt sized Wirewound?

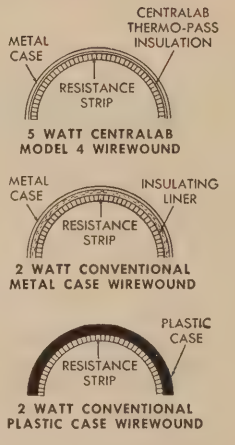
it's easy with

Centralab's "Thermo-Pass" Insulation

Nowadays all kinds of critters have Texas capacity with Rhode Island size. Tubes, relays, and many other components have gotten smaller without any sacrifice in performance.

Now it's true with wirewounds, too! CENTRALAB has corralled 5 watts of power in a 2-watt size wirewound . . . by using "Thermo-Pass" insulation. A control's rating and size depend on the speed with which heat can be transferred from the resistance element to the atmosphere. CENTRALAB "Thermo-Pass" insulation combines exceptional heat transfer with a dielectric strength of 4500 volts per mil at 25° C. Result: a conservatively rated 5 watt Radiohm control measuring only 1 3/32" in diameter and 9/16" in depth. They are available in values from 1 ohm to 100 K ohms.

Meanwhile, back at the ranch, you'll find this one small size taking care of your 2, 3, 4 and 5 watt replacements in tv, hi-fi, home and auto radio sets. Just make sure you use the wirewounds—short (Model WN) or long (Model WW) shaft style—that carry the ERL brand.



Centralab
B-6001 ®

A DIVISION OF GLOBE-UNION INC.
900 E. KEEFE AVE. • MILWAUKEE 1, WIS.
IN CANADA: 669 Bayview Avenue • Toronto 17, Ont.

CONTROLS • ROTARY SWITCHES • CERAMIC CAPACITORS
PACKAGED ELECTRONIC CIRCUITS • ENGINEERED CERAMICS

NEWS BRIEFS *(Continued from p. 14)*

Calendar of Events

National Symposium on Reliability & Quality Control, Jan. 11–13, Statler-Hilton Hotel, Washington, D. C.

ISA Instrument-Automation Conference and Exhibit, Feb. 2–4, Sam Houston Coliseum, Houston, Tex.

Winter Convention on Military Electronics, Feb. 3–5, Ambassador Hotel, Los Angeles, Calif.

Solid State Circuits Conference, Feb. 10–12, University of Pennsylvania, Philadelphia, Pa.

Cleveland Electronics Conference, Feb. 11–12, Engineering and Scientific Center, Cleveland, Ohio.

ERA National Convention, Feb. 11–13, Drake Hotel, Chicago, Ill.

Distributor - Representative - Manufacturer Conference, Feb. 18–21, El Mirador Hotel, Palm Springs, Calif.

International Electronic Parts Show, Feb. 19–23, Parc des Expositions, Porte de Versailles, Paris, France.

Scintillation Counter Symposium, Feb. 25–26, Washington, D. C.

Hi-Fi Shows

IHFM Hi-Fi Show, Jan. 13–17, Pan-Pacific Auditorium, Los Angeles, Calif.

National Hi-Fi Show, (sponsored by MIRA) Jan. 23–26, Cow Palace, San Francisco, Calif.

Details on all events supplied by sponsoring organizations.

ELECTRONIC HEARTBEAT timer (pacemaker) with no external wiring can be sewn into patient's chest near his heart because it has self-contained batteries. The circuitry is in a plastic envelope about 2½ inches in diameter, ⅝ inches thick. Presently used devices require external power and carry some danger of infection where wires enter body.

The timer supplies a stimulating pulse at regular intervals to keep the heart beating regularly, where otherwise it might beat dangerously out of time, slow down or stop entirely.

This heart timer will run for 5 years, has been tested on dogs for periods up to 100 days. Dr. Wm. Chardack, of the Veteran's Aministration, and electronic consultant Wilson Greatbatch of Buffalo, N. Y., developed the device.

Meanwhile, it was reported that RCA has developed a heart timer using a generator strapped around the patient's chest which induces power into a device sewn inside his chest cavity.

INSTANT MAIL BY FACSIMILE is the goal of a project for which the Post Office Department has awarded a development contract to IT&T. The company has already installed facsimile equipment in Los Angeles and in Washington, D. C., and is sending experimental transmissions using wire line.

Ultimately, it is believed, a special scanner will "read" the message through the envelope, transmit it via microwave (or coaxial cable) and rewrite it in a sealed envelope at the other end.

Cost of instant mail could be lower than 2 cents for a cross-country letter compared with present 7 cents for air mail. END

Correspondence

PART TIMERS 20 TO 1?

Dear Editor:

In the Technicians News column of the September issue you quoted part of a NATESA publication article which said that part-timers were outnumbering regulars by 20 to 1.

I'll wager that in any large city where there are several trade schools you will find that there are some 60 to 100 part-timers entering into the "racket" every month!

It is the most natural thing in the world for recent students to be asked by neighbors to repair their TV receivers. (And washing-machine line cords, electric clocks, irons, toasters or what have you.)

If you were a little ol' lady living in Apt. 4-A, wouldn't you ask the big strong man living in 4-B to come over and move the piano before you would call up some furniture moving outfit and pay maybe $10 or $12 for the job?

Some of these TV associations complaining about the evils of spare-time servicing should check into the side activities of their own employees.

One would have to be awfully naive to believe that the prize technician of Joe Blows Shoppe is going to answer his grandma's frantic plea for technical assistance by telling her to call in a report to the shop when it opens Monday morning.

It has just occurred to me that most of the correspondence school ads in RADIO-ELECTRONICS depend for a large part of their appeal on the "make money in your spare time while you learn" angle.

Sooner or later you gentlemen at RADIO-ELECTRONICS are going to have to get off the fence and take *one* side or the other. *That* will be something to watch!

LEE LAMASCUS

Hollywood, Calif.

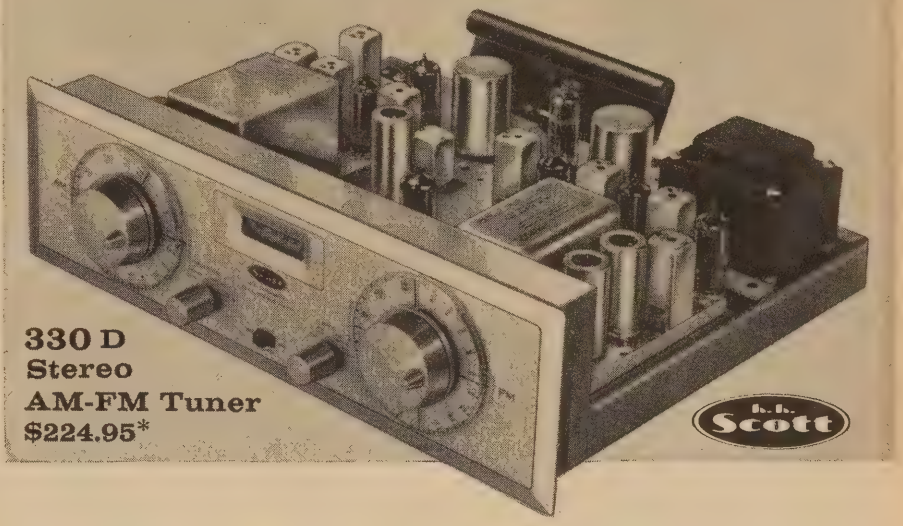
[We never have been on the fence. We have always been on the side of the honest, competent service technician, no matter whether he is part-time or full-time. What we are against is the dishonest, the incompetent and the chiseling operators, whether part-time or full-time. Honest part-timers offer less competition to the full-timer than the "$1-a-call" boys and the dishonest fringe.

The fact that we report what some service associations think about some part-timers doesn't necessarily mean

(*Continued on page* 24)

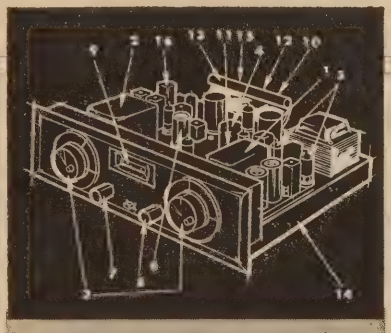
3 NEW TUNERS FROM

H.H. SCOTT



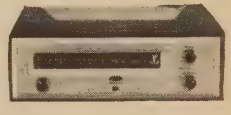
Wide-Band FM...Wide-Range AM Make These World's Most Sensitive, Most Selective Tuners!

The completely separate FM section of the radically new H. H. Scott 330D stereo tuner utilizes H. H. Scott's exclusive Wide-Band FM circuitry to assure absolutely drift-free and interference-free reception in even the weakest signal areas. Wide-Band design also lets you separate stations so close together on the dial that ordinary tuners would pass them by. The separate AM section utilizes H. H. Scott's unique Wide-Range detector so that, for the first time, you can receive full range AM broadcasts with fidelity and frequency response comparable to FM. Special multiplex adaptor facilities let you convert to multiplex at any time.



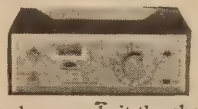
1. Separate FM front-end, silver plated for maximum sensitivity. 2. Separate AM front-end. 3. Separate AM and FM professional tuning controls. 4. Wide-Band FM detector for distortion-free reception on all signals. 5. Highly selective FM IF stages permit separation of stations close together on dial. 6. Wide-range AM detector. 7. Selector switch. 8. Band switch with these positions: FM, AM Wide, AM Normal, AM Distant. 9. Illuminated tuning meter. 10. Stereo output jacks. 11. Jack for instant connection of multiplex adaptor. 12. Stereo tape recorder output jacks. 13. AM Ferrite Loop Antenna. 14. Chassis constructed of heavy copper bonded to aluminum to insure reliability. 15. 10 KC whistle filter. Specifications: FM sensitivity 2 microvolts for 20db of quieting; (IHFM rating 2.5 μv); FM detector bandwidth 2 megacycles.

320 AM-FM TUNER



The many fine features built into this superlative tuner, including Wide-Range AM and Wide-Band FM, have never been available before for less than $200. This tuner is ideal where AM-FM stereo reception is not available. $139.95*

310C FM TUNER



This professional tuner is the most sensitive and selective available. Its outstanding performance and sensitivity have made it the choice of universities and laboratories throughout the world. Sensitivity 1.5 μv for 20 db of quieting. (IHFM rating 2 μv) $174.95*

*Slightly higher West of Rockies. Accessory case extra.

H.H. SCOTT

H. H. Scott, Inc., 111 Powdermill Rd., Dept. RE-1, Maynard, Mass.

Rush me new catalog and complete technical specifications on all new H. H. Scott components.

Name.....

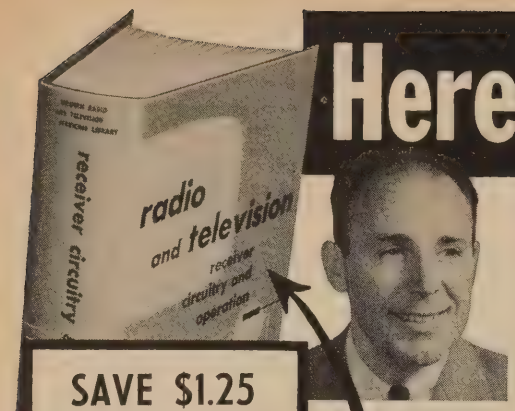
Address.....

City.....State.....

Export: Telesco International, 36 W. 40th St., N.Y.C.

HEAR THE FABULOUS LONDON-SCOTT INTEGRATED STEREO ARM AND CARTRIDGE

Here's the SPECIALIZED



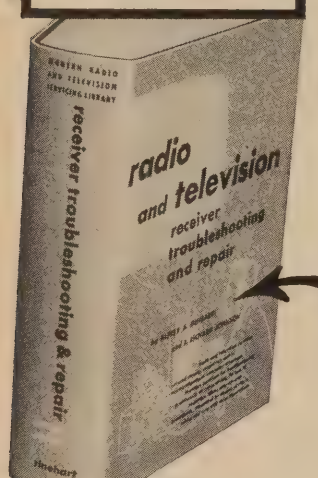
A. A. GHIRARDI

Let these 2 Ghirardi manuals teach you to REPAIR ANY TELEVISION OR RADIO RECEIVER ever made!

SAVE $1.25

Make your service library complete! Get *both* these famous Ghirardi books at a saving of $1.25 under the regular price. See MONEY-SAVING COMBINATION OFFER in coupon.

Let these two famous training books teach you to handle all types of AM, FM and TV service jobs by approved *professional* methods —*and watch your efficiency and earnings soar!* Almost 1500 pages and over 800 clear pictures and diagrams explain EVERY troubleshooting and repair operation as clearly as A-B-C. No needless mathematics. No involved theory. You get straight-from-the-shoulder training of the type that teaches you to do the best work in the shortest time. Each book is co-authored by A. A. Ghirardi whose radio-electronics training guides have, for more than 25 years, been more widely used for military, school and home study training than any other books of their types. Books are sold separately at prices indicated—or you save $1.25 by buying them both. Use coupon or order from Rinehart & Co., Inc., Dept. RE-10, 232 Madison Ave., New York 16, N. Y.



① RADIO & TV CIRCUITRY and OPERATION

Learn about circuits . . . and watch service headaches disappear

You can repair ANY radio, TV or other electronic equipment lots easier, faster and better when you're fully familiar with its circuits and know just why and how each one works . . . and that's exactly the kind of specialized training you get in Ghirardi's 669-page Radio & TV CIRCUITRY AND OPERATION training guide. First it gives a complete understanding of basic modern circuits and their variations. Finally it shows what troubles to look for and how to eliminate useless service testing and guesswork. Throughout, it gives you the above-average training that takes the "headaches" out of trouble-shooting—the kind that fits you for the best-paid servicing jobs. Contains 417 clear illustrations.

Sold separately for $6.75—or see MONEY-SAVING COMBINATION OFFER.

② RADIO & TV TROUBLESHOOTING and REPAIR

Complete training in modern service methods

Radio & TV TROUBLESHOOTING AND REPAIR is a complete 822-page guide to ***professional*** service methods . . . the kind that help you handle jobs faster, more profitably. For beginners, this giant book with its 417 clear illustrations is an easily understood course in locating troubles fast and fixing them ***right.*** For experienced servicemen, it is an ideal way to develop better methods and shortcuts; or to find fast answers to problems. You learn troubleshooting of all types from "static" tests to dynamic signal tracing methods. Step-by-step charts demonstrate exactly what to look for and how to look. A big television section is a down-to-earth guide to all types of TV service procedures. Read it 10 days at our risk!

Sold separately for $7.50 or save $1.25 on MONEY-SAVING COMBINATION OFFER.

Get More Work Out of Fewer Instruments!

BASIC ELECTRONIC TEST INSTRUMENTS
254 Pp. 171 illus.
Price $4.95

Save time . . Save money . . Avoid buying instruments you don't really need!

It pays to think twice before you buy new instruments — without first determining whether you really need them — or just how and where you'll actually use them!

BASIC ELECTRONIC TEST INSTRUMENTS is an instrument guide especially for servicemen, amateurs and experimenters. It explains modern instrument types and the advantages and limitations of each. It shows how to choose the instruments you really need; how to understand instrument readings and put them to practical use; how to work with fewer instruments, and how to put old instruments to new uses.

Over 60 instrument types discussed include everything from simple current and voltage meters to ohmmeters and V-O-M's; V-T voltmeters; power meters; impedance meters; capacitor checkers; inductance checkers; special-purpose bridges; oscilloscopes; R-F test oscillators; signal generators; audio test oscillators; R-F and A-F measuring devices; signal tracers; tube testers; grid-dip oscillators; TV sweep and marker generators; square wave generators; distortion meters and many others. It helps you work better—and saves you money.

Check BASIC ELECTRONIC TEST INSTRUMENTS in coupon for 10-day FREE examination

Now! FIX ANY ELECTRIC MOTOR!

TRAIN FOR BETTER PAY IN A FIELD THAT ISN'T CROWDED!

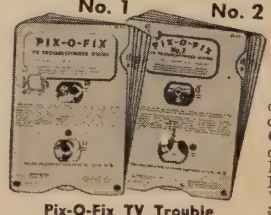
Handle ANY job from minor repairs to complete rewinding
560 pages—
Over 900 how-to-do-it pictures

It pays to train for something different! ELECTRIC MOTOR REPAIR is a complete guide that helps you cash in on this vast, rapidly growing field. Shows step by step how to handle all repair jobs (including complete rewinding) on practically ANY AC or DC motor or generator in common use — from fractional horsepower to giant industrial motors. Special duo-spiral binding brings text and related how-to-do-it diagrams side by side so that you learn fast, easily and right. Every job is explained so clearly you can hardly fail to understand it. Over 125,000 copies in use in motor repair shops, schools, and for home study. Fully approved by repair specialists, unions and instructors.

It's the ideal book whether you want to train for a good-pay motor repair job or simply want to fix motors as a sideline or hobby!

Order ELECTRIC MOTOR REPAIR in coupon. Price only $6.95.

SHORT CUT TO TELEVISION REPAIRS



Pix-O-Fix TV Trouble Finder Guides
Only $2 for the two

Eliminate useless testing . . . Fix sets twice as fast

Just turn the dial of the handy, pocket-size Ghirardi & Middleton PIX-O-FIX TV Trouble Finder Guide. When the picture in the PIX-O-FIX window matches the screen image on the television set you're repairing . . . ***presto! . . . you've got your clue.***

PIX-O-FIX then shows the causes of the trouble. Next it indicates the exact receiver section in which the trouble has probably happened. Then it gives step by step repair instructions.

The two PIX-O-FIX units No. 1 and No. 2 cover 48 different television troubles . . . just about anything you're likely to be called on to fix. No. 1 identifies 24 of the most common troubles and gives 192 causes and 253 remedies for them. No. 2 covers 24 more advanced troubles not included in No. 1. Together, they are a comprehensive guide to quick "picture analysis" servicing of any TV set . . . ***AND THE PRICE IS ONLY $2.00 for the two.*** Money-back guarantee. ***Specify PIX-O-FIX in coupon.***

USE COUPON FOR *10-day Free Trial!*

TRAINING YOU NEED

in its most complete economical and easily understood form

Here's everything you need to know ABOUT OSCILLOSCOPES!

Complete data on getting the most out of the handiest, most versatile instrument of all!

Oscilloscopes are "gold mines" if you learn to use them fully on every job.

THIS BIG BOOK TEACHES YOU HOW!

Here, in a big, revised 2nd edition, is THE book that really shows you how to get more work out of your oscilloscope.

Clearly as A-B-C MODERN OSCILLOSCOPES AND THEIR USES gets right down to "brass tacks" in telling you exactly when, where and how. You learn to locate either AM or FM radio or television troubles in a jiffy. Even tough realignment jobs are made easy. No involved mathematics! Every detail is clearly explained—from making connections to adjusting circuit components and setting the oscilloscope controls. And you learn to analyze patterns fast and RIGHT!

Includes latest data on quantitative measurements (the slickest method of diagnosing many color TV troubles and aligning sets properly); using 'scopes in industrial electronics, teaching . . . even in atomic energy work. Over 400 helpful pictures including dozens of pattern photos make things doubly clear. Price $6.50.

'SCOPE EXPERTS

Oscilloscope experts get the BIG PAY jobs!

Practice 10 days free. Order MODERN OSCILLOSCOPES in coupon.

Down-to-earth training in

BASIC ELECTRONIC TEST PROCEDURES

It's what you know about fast, accurate testing that really counts!

This new 316-page book with more than 190 how-to-do-it pictures and procedure sketches teaches you to test any circuit, equipment or component in a fraction of the usual time. Teaches you PROFESSIONAL test procedures and instrument techniques. Covers different ways of doing specific jobs. For instance, you learn to check for distortion by the 'scope, rejection filter, harmonic distortion meter, wave analyzer or oscillator methods. You learn to measure resistance with a current meter, a volt-ammeter, a voltmeter, an ohmmeter, or via the bridge method . . . and so on through all types of tests.

Includes Current checks; measuring Power, Capacitance, Resistance, AF, RF, Phase, Distortion & Modulation; testing Tubes and Semiconductors; testing Amplifiers; checking Sensitivity, RF, Gain, Fidelity, AVC Voltage, etc.; visual alignment techniques and all the rest. Also covers industrial electronic test procedures. Everything is *really* complete—and written so you can understand it! Price $6.50.

Specify BASIC ELECTRONIC TEST PROCEDURES in coupon for 10-day free trial!

HOW TO GET YOUR TICKET in a jiffy!

LICENSE MANUAL for Radio Operators

by J. R. Johnson (W2BDL)

A complete, practical study guide for getting your "ticket" as a well paid commercial operator.

Cash in on radio where the pay is best!

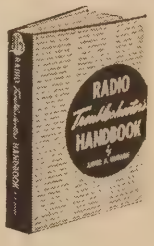
Get one of radio's best paying jobs—as a commercial operator aboard ship, in aviation, in broadcasting or telecasting and the many other places where an FCC license is a "must"!

LICENSE MANUAL FOR RADIO OPERATORS by J. R. Johnson is a quick, low-cost guide to help you breeze through FCC exams. Written so you can easily understand and remember it. Covers ALL EIGHT exam elements—not just some of them. Reviews almost 2200 typical questions. Gives straight-to-the-point answers. Includes the changes in exam elements 1 and 2. Covers all data from electrical and radio fundamentals to navigation and related subjects.

JOB OPPORTUNITY NEWS! Under a new ruling, only holders of 1st or 2nd class radio-phone licenses can do any work that affects the broadcasting of a transmitter. This is just one of many good job opportunities open to license holders!

Check LICENSE MANUAL FOR RADIO OPERATORS in coupon. Price only $5.00

DON'T THROW OLD RADIOS AWAY!



Covers every model made by 202 mfrs. from 1925 to 1942

Here's the data you need to fix old sets in a jiffy!

Just look up the how-to-do-it data on that trouble-some old radio you want to fix.

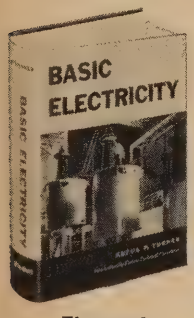
Four times out of 5, this giant, 3½-pound, 744-page Ghirardi RADIO TROUBLESHOOTER'S HANDBOOK tells what is likely to be causing the trouble . . . shows how to fix it. No useless testing. No wasted time. Using it, even beginners can easily fix old sets which might otherwise be thrown away because service information is lacking. With a few simple repairs, most of these old sets can be made to operate perfectly for years to come.

THE ONLY GUIDE OF ITS KIND!

Cuts service time in half!

Included are common trouble symptoms and their remedies for over 4,800 models of old home, auto radios and record changers. Airline, Apex, Arvin, Atwater Kent, Belmont, Bosch, Brunswick, Clarion, Crosley, Emerson, Fada, G-E, Kolster, Majestic, Motorola, Philco, Pilot, RCA, Silvertone, Sparton, Stromberg and dozens more. Includes hundreds of pages of invaluable tube and component data, service short cuts, etc.

Specify RADIO TROUBLESHOOTER'S HANDBOOK in coupon. Price only $6.95. 10-day trial.



The most important training of all!

HERE'S HOW TO GET AHEAD IN RADIO-ELECTRONICS

No matter what you want to do in radio-electronics, this brand new 396-page BASIC ELECTRICITY manual represents *the most important training of all.* Learn your basic electricity, learn it fully—then everything else in electronics, radio, TV, communications, hi-fi and all the rest comes 10 times as easy—*because they're all based on the same fundamental electrical principles.*

BASIC ELECTRICITY covers the entire field . . . from circuits and currents to electromagnetism . . . from polyphase to 'phone principles . . . from tubes to transistors . . . from batteries, instruments and measurements to motors, generators, transformers, and dozens of related subjects. More than 300 pictures make everything doubly clear. Set-up diagrams explain procedures. Basic electrical problems and their solutions are included. Then, to top your basic training off, the book includes a complete, easy-to-understand 61-page **INTRODUCTION TO ELECTRONICS.** Backed with this great training you'll read technical articles with new meaning. You'll know what's what about circuits and their components. Every detail of electrical-electronic operation will be far clearer to you than ever before! Price only $6.50.

Check BASIC ELECTRICITY in coupon for 10-day Examination. See for yourself!

TRY ANY BOOK 10 DAYS FREE!

Dept. RE-10, Rinehart & Company, Inc.
232 Madison Ave., New York 16, N. Y.

☐ **Check here for MONEY-SAVING COMBINATION OFFER**

. . . on Ghirardi's Radio & TV Receiver CIRCUITRY AND OPERATION, and Radio & TV Receiver TROUBLESHOOTING AND REPAIR. Price only $13.00 for the two books plus postage. (Regular price $14.25 . . . *you save $1.25.*) Payable at rate of $4 (plus postage) after 10 days and $3 a month for three months until $13.00 has been paid. If not satisfactory, return books in 10 days and owe nothing.

Check here to order INDIVIDUAL BOOKS

Sent on 10 day free examination. For cash with order we pay postage—money-back guarantee. Otherwise postage extra.

- ☐ **Radio & TV Receiver CIRCUITRY & OPERATION....$6.75**
- ☐ **Radio & TV Receiver TROUBLESHOOTING & REPAIR. $7.50**
- ☐ **BASIC ELECTRONIC TEST INSTRUMENTS $4.95**
- ☐ **ELECTRIC MOTOR REPAIR....$6.95**
- ☐ **PIX-O-FIX TROUBLE FINDER GUIDES (Nos. 1 and 2).....$2.00**
- ☐ **BASIC ELECTRONIC TEST PROCEDURES $6.50**
- ☐ **MODERN OSCILLOSCOPES AND THEIR USES $6.50**
- ☐ **RADIO TROUBLESHOOTER'S HANDBOOK $6.95**
- ☐ **BASIC ELECTRICITY $6.50**
- ☐ **LICENSE MANUAL for Radio Operators $5.00**

To order OUTSIDE U.S.A.—$14.00 for money-saving combination offer. For all other books, add 50¢ each to above prices for handling through customs, etc. Sold for cash only. Any book may be returned in 10 days and money will be refunded.

Name.....

Address.....

City, Zone, State.....

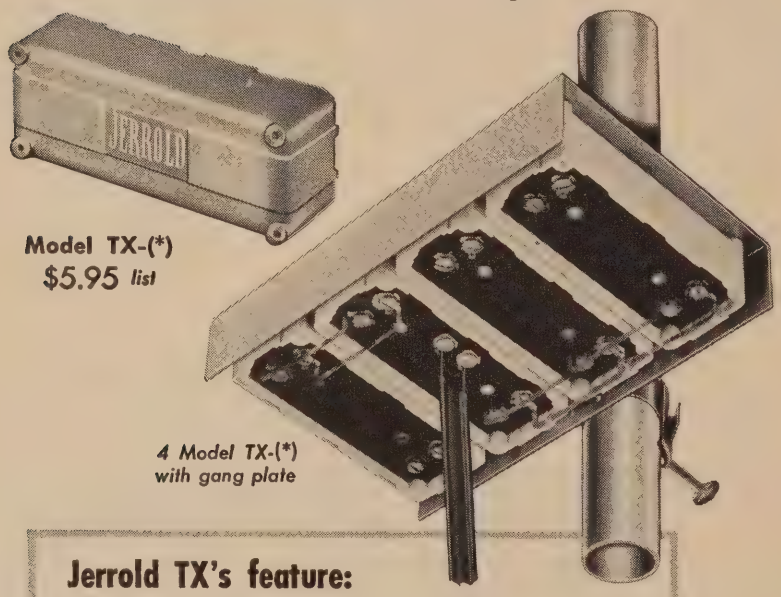
NEW!

JERROLD ANTENNA MIXING NETWORKS

MODEL TX-(*)

Give Multi-Channel, All-Direction Reception Simultaneously...for FM, TV, UHF and Color!

Now multi-set families can have all-direction reception at the same time on *one common line!* No more rotators or switches . . . the versatile Jerrold Model TX-(*) can be used individually or in any combination to reject unwanted channels and to bring in weaker stations bright and clear. They will mix cut-to-channel antennas with a single broad band antenna . . . separate individual channels . . . mix or separate VHF and UHF . . . and mix or separate VHF TV and FM . . . *all without loss of signal.*



Model TX-(*)
$5.95 *list*

4 Model TX-(*) with gang plate

Jerrold TX's feature:

- up to 9 antennas on a single down lead
- high Q band-pass circuit for highest rejection
- negligible feed-thru loss . . . less than a knife switch
- matched mixing jumpers . . . for low VSWR
- unbreakable attractive housing, complete with hardware
- universal mounting . . . indoor or outdoor

*SPECIFY UNITS DESIRED: any TV channel from 2 through 13; FM; H-L (VHF high-low) or VHF-UHF

JERROLD ELECTRONICS CORPORATION, Distributor Sales Division
Dept. PD 193, The Jerrold Building, Phila. 32, Pa.

Jerrold Electronics (Canada) Limited
Export Representative: CBS International, New York 22, N. Y.

LOOK TO JERROLD FOR AIDS TO BETTER TELEVIEWING

we agree. (And even the service organizations recognize that legitimate part-timers exist—see page 136, November, 1959, RADIO-ELECTRONICS.) After 51 years in this field, we are well aware that many of today's part-timers are tomorrow's full-timers, and that we have large numbers of both kinds of technicians among our readers.—*Editor*]

CREDIT WHERE CREDIT IS . . .

Dear Editor:

Congratulations on your new section on INDUSTRIAL ELECTRONICS. Articles of this sort should prove extremely valuable to your readers.

I was especially interested in "Printed Circuits Are Here to Stay," page 48 in your November 1959 issue. It is an excellent discussion and review of the printed- and packaged-circuit field.

However, there was one important omission. The article stated that the "National Bureau of Standards developed the printed circuit using a ceramic base." Though this is true, your author neglected to say that this work was done by the NBS cooperatively with Centralab. As a matter of fact, the proximity fuze mentioned was manufactured by us and all the original techniques for its manufacture were developed by the NBS and Centralab working as a team.

Our contributions to packaged circuits were noted in James P. Baxter's *Scientists Against Time*, in which he reviewed America's wartime scientific accomplishments, ". . . a highly ingenious system of manufacturing circuit components such as capacitors and resistors and the connections between them, by new techniques in the field of ceramics developed by Centralab, Div. of Globe-Union, permitting considerable saving in space."

FRANK L. APPLE
Centralab Div. of Globe-Union, Inc.
Milwaukee, Wis.

Dear Editor:

We of TELautograph Corp. were disappointed in errors contained in Mr. Aaron Nadell's article "Electronics Works on the Railroad" (November, 1959, page 46).

The Penn Station installation is one of the largest TELautograph installations. Our equipment plays a major part in the overall reservation system.

Specifically, the TELautograph equipment is leased to the Pennsylvania Railroad by our company and we, too, have servicemen who check this equipment each morning and evening. It is definitely *not* Western Union equipment nor is it maintained by their servicemen. We also spell our company name with a capital TEL.

The TELautograph Corp. was founded late in the 19th century by Elisha Gray and our stock has been traded on the New York exchange since 1906. We have service offices and representatives in 114 cities throughout the United States and all major market centers of the world. Our products include the

WE'RE MAKING IT EASIER THAN EVER TO BECOME A WELL PAID

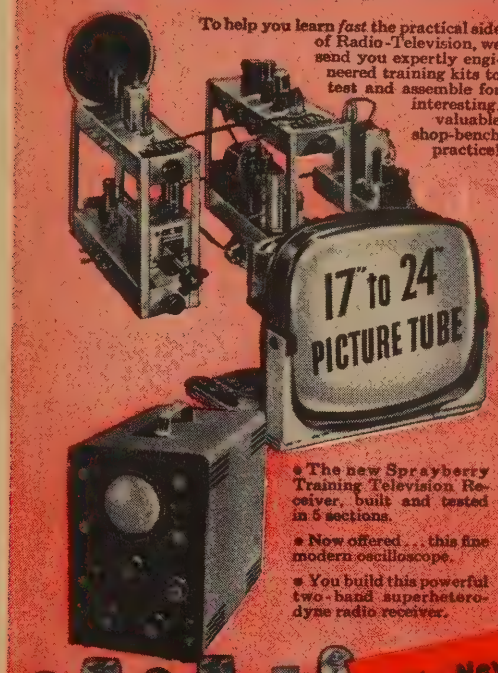
RADIO-TELEVISION SERVICE TECHNICIAN

NOW — Just $6 Starts You Training in RADIO-TELEVISION

the SPRAYBERRY "Learn-by-Doing" Way . . .

25 BIG, COMPLETE KITS of PARTS & EQUIPMENT

To help you learn *fast* the practical side of Radio-Television, we send you expertly engineered training kits to test and assemble for interesting, valuable shop-bench practice!



- The new Sprayberry Training Television Receiver, built and tested in 5 sections.
- Now offered . . . this fine modern oscilloscope.
- You build this powerful two-band superheterodyne radio receiver.

Big New CATALOG AND Sample Lesson FREE!

You build the new Sprayberry tester—a complete 18-range Volt-Ohm-Milliammeter test meter.

★ ★ ★ ★ This great industry is begging for trained men . . . to step into good paying jobs or a profitable business of their own! Our new plan opens the doors of Radio-Television wide to every ambitious man who is ready to act at once!

Men by the thousands... trained Radio-Television Service Technicians...are needed at once! Perhaps you've thought about entering this interesting, top paying field, but lack of ready money held you back. Now—*just $6 enrolls you* for America's finest, most up to date home study training in Radio-Television! Unbelievable? No, the explanation is simple! We believe Radio-Television *must* have the additional men it needs as quickly as possible. We are willing to do our part by making Sprayberry Training available for less money down and on easier terms than ever before. This is your big opportunity to get the training you need...to step into a fine job or your own Radio-Television Service Business.

Complete Facts Free—Act Now; Offer Limited

Only a limited number of students may be accepted on this liberal and unusual basis. We urge you to act at once...mail the coupon below and get complete details plus our big new catalog and an actual sample lesson—*all free.* No obligation...no salesman will bother you.

HOME STUDY TRAINING IN SPARE TIME

Under world-famous 27-year old Sprayberry Plan, you learn entirely at home in spare time. You keep on with your present job and income. You train as fast or as slowly as you wish. You get valuable kits of parts and equipment for priceless shop-bench practice. And everything you receive, lessons and equipment alike, is all yours to keep.

LET US PROVE HOW EASILY YOU CAN LEARN!

Radio-Television needs YOU! And Sprayberry is ready to train you on better, easier terms, that any ambitious man can afford. *Just $6 starts you!* Mail coupon today... let the facts speak for themselves. You have everything to gain. Let us prove the kind of opportunity that's in store for you!

SPRAYBERRY Academy of Radio-Television
1512 Jarvis Avenue, Dept. 20-F, Chicago 26, Illinois

Mail This Coupon Now—No Salesman Will Call

Sprayberry Academy of Radio-Television
Dept. 20-F, 1512 W. Jarvis Ave., Chicago 26, Ill.

Please rush all information on your ALL-NEW Radio-Television Training Plan. I understand this does not obligate me and that no salesman will call upon me. Include New Catalog and Sample Lesson FREE.

NAME..... Age.....

ADDRESS.....

CITY..... ZONE..... STATE.....

Telescriber, Teletypewriter and closed-circuit television. Through our subsidiaries, Hogan Faximile, Inc., and Teletronic Security Systems, Inc., we provide high-speed data facsimile and facsimile paper and government and commercial security systems.

Incidentally, Bremy's Electronics in Paterson, N. J., is a representative of the TELautograph Corp. His article also appears in the November issue of your magazine.

JOSEPH M. CRAWFORD

TELautograph Corp.
Los Angeles, Calif.

SAVING MAGAZINES?

Dear Editor:

On page 24 of your November issue Mr. Bemis suggested clipping RADIO-ELECTRONICS articles for storage and filing them in a loose-leaf notebook to save storage space. This method requires more than a little work and articles discarded today will often be of great interest years hence. For example, today I have absolutely no interest in hi-fi. Yet several years from now . . . who knows?

My space-saving method is to file RADIO-ELECTRONICS copies upright, book-fashion, in a canned food carton. Grocery stores are happy to provide the correct size: a carton for 24 No. 2½ cans. This holds just 4 years' issues neatly. To separate the years and keep the top from sagging, I insert dividers cut from other cartons. I file the January to November issues together and put the four December issues (with the annual indexes) in one end.

This way any copy can be found as easily as taking a book from a shelf. The magazines remain in good condition, unmutilated. Indexing is automatic. And you guessed it . . . there is much less work involved.

JOSEPH H. SUTTON

Kansas City, Mo.

GENERATING SPIRALS?

Dear Editor:

Readers of Mr. Jaski's "Better Yet, Use A Spiral" (November, 1959, page 88) should be warned that they may be disappointed in generating polar-coordinate patterns by modulating ahead of the deflection amplifiers, unless the scope used has very good, linear deflection amplifiers with identical phase shift. If the radial modulation frequencies are *lower* than the circle frequency, the sidebands produced may not be too far from the circle frequency to use the spiral for time measurement.

If one should wish to use it for some other purpose such as frequency comparison at high ratios or study of the actual waveshape of nonrecurrent transients on a much longer axis than the 5-inch X-axis, the radial modulation frequencies will be much higher than the circle frequency, and severe distortion will result.

If, for example, a 1,000-cycle circle is to be modulated at 50 kc to produce a sinusoidal cogwheel, each deflection amplifier must amplify 1,000 cycles, 49 kc and 51 kc. And this must occur identically in both amplifiers without generating any 2,000 cycles or 50 kc, as will happen if there is any nonlinearity.

The safest and easiest way to generate perfect patterns is to modulate in the last deflection stage, as most users of polar coordinates have done in the past. My old article, "Stroboscopic Interpolation," *Radio & Television News,* (Engineering Edition), January, 1954, contains full details of suppressor-modulated deflection amplifiers as well as details of a 1936 chronograph which used the spiral trace, and a bibliography of still earlier work with polar patterns.

One can easily add optional polar coordinates to any scope having identical X and Y push-pull output stages with suppressor grids accessible. One might also add them with no circuit changes at all, using a PPI radar tube directly interchangeable with one's CRT. The one I tried in 1944, a DuMont, had a terminal in the middle of the screen for polar deflection.

ALBERT H. TAYLOR

Read Island
British Columbia

END

RESIDENT SCHOOL COURSES
Industry needs Electronic Technicians!
Let RCA train you in Advanced Electronics
This is the college-level training you need to work with professional engineers on research, development or production projects in such fields as: automation, guided missiles, radar, television, computers and other advanced electronic applications.
RCA Institutes Resident Schools in New York City offers this comprehensive course that prepares you for any field of electronics you may choose. Other courses in TV & General Electronics, Radio & TV Servicing, and Radio Telegraph Operating.
Classes start four times each year. Applications now being accepted. Approved for Veterans.
RCA INSTITUTES, INC.
SCHOOLS OF TELEVISION AND ELECTRONIC TECHNOLOGY
A Service of Radio Corporation of America
Another way RCA Serves Education through Electronics

RCA INSTITUTES, DEPT. RER-10
350 W. Fourth St., N. Y. 14, N. Y.

Please send me your FREE catalog of Resident School courses in New York.

NAME.....
please print

ADDRESS.....

CITY.....ZONE.....STATE.....

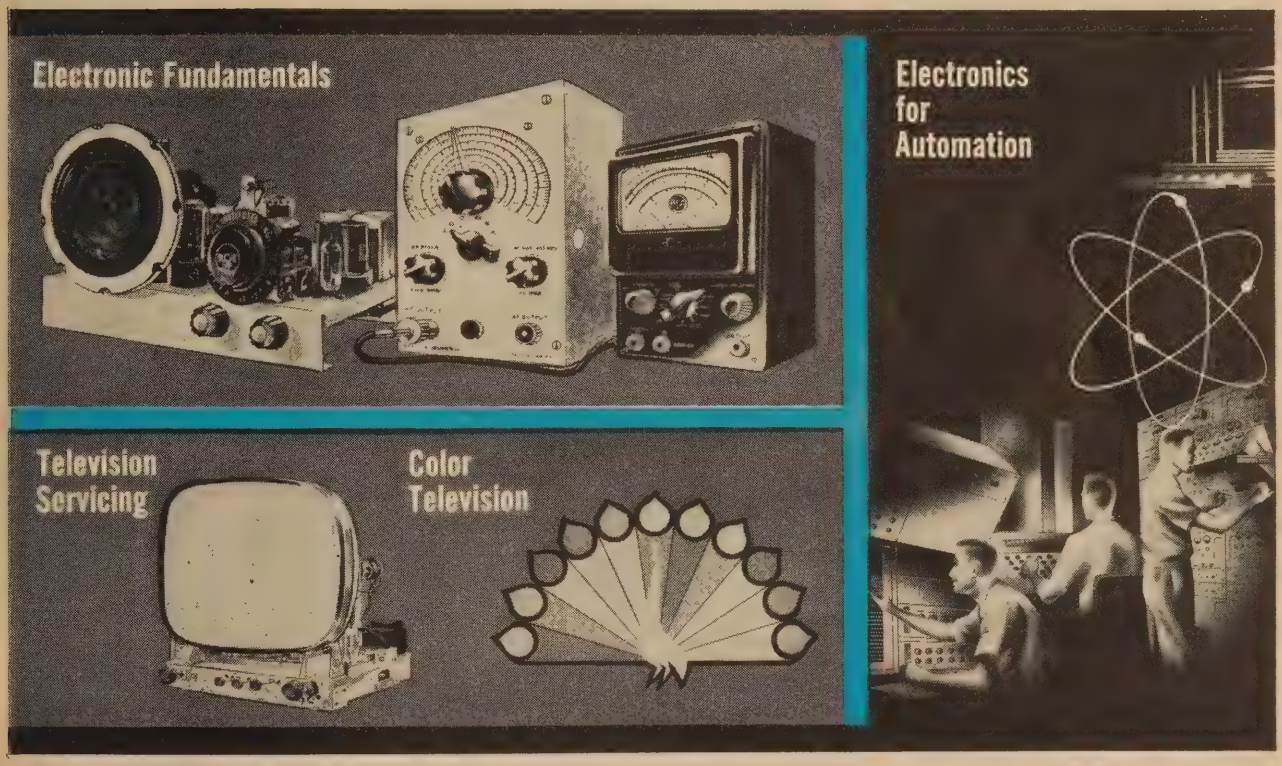
For Home Study Courses see ad on opposite page

LET RCA TRAIN YOU IN ELECTRONICS

RCA Institutes, one of the world's leading electronic technical schools, offers a Home Study Course in . . .

ELECTRONICS FOR AUTOMATION

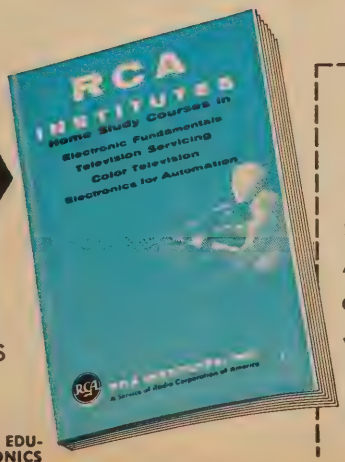
. . . Now you have *four* comprehensive courses for your electronic training . . . from basic electronic theory to the more advanced principles of color TV and Automation.



Practical work with the very first lesson. Pay-as-you-learn. You need pay for only one study group at a time.

Send for our 64 page Home Study Catalog

FREE!



FOR RESIDENT SCHOOL COURSES SEE AD ON OPPOSITE PAGE

ANOTHER WAY RCA SERVES EDUCATION THROUGH ELECTRONICS

RCA INSTITUTES, Inc. Home Study School, Dept. ZRE-10
A Service of Radio Corporation of America
350 West Fourth Street, New York 14, N. Y.

Without obligation, send me the FREE catalog of Home Study Courses. No salesman will call.

Name ..... Age .....
Please print
Address .....
City ..... Zone ..... State .....
Veterans: Enter discharge date .....

CANADIANS — Take advantage of these same RCA courses at no additional cost. No postage, no customs, no delay. Send coupon to:
RCA Victor Company, Ltd., 5001 Cote de Liesse Rd., Montreal 9, Quebec

1

number one of a series of Cornell-Dubilier 50th Anniversary Deals!

CDE

MINIATURIZED

MYLAR

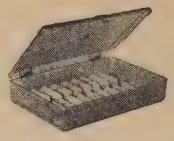
FOR THE PRICE OF PAPER

You read it right! Now you can get C-D's **miniaturized** 100% Mylar* film-wrapped capacitors at prices you'd normally expect to pay for paper-dielectric types! And these C-D Mylars—with their epoxy-anchored leads—are the universal types you use daily, especially for hard-to-get-at repairs. Not a dust-collector in the assortment!

HERE'S THE DEAL:

Quantity	Type No.	Capacitance (mfd.) ±10% Tolerance	Voltage (DCW)
10	WMF6S1	.01	600
10	WMF6S22	.022	600
10	WMF6S47	.047	600
10	WMF6P1	.1	600

All 40 pieces for only ~~$11.40~~ $8.70 (dealer net)



HERE'S THE PACKAGE: Typical of the quality C-D builds into **every** capacitor in their complete line, the assortment's sturdy, space-saving, clear plastic container fits easily into your tool kit. And, when the box is empty, it's perfect for holding small tools and parts you want at a moment's notice.

HERE'S HOW TO GET IN ON IT: First in a Series of C-D 50th Anniversary Deals; this limited-time offer is designed to save you money...help you do your job better, easier...keep your customers happy! Get the whole story —**and the deal**—from your C-D Distributor. Call him **today!** Get in on Cornell-Dubilier's 50th Anniversary Sales Celebration. (Also ask about C-D's complete capacitor line for industrial electronic maintenance.)

*Du Pont Reg. T.M.

CDE **CORNELL-DUBILIER ELECTRIC CORPORATION**
Affiliated with Federal Pacific Electric Company

In STEREO and Mono Hi-Fi . . . the experts say your best buy is EICO

"The overall design of the HF-81 is conservative, honest and functional. It is a good value considered purely on its own merits, and a better one when its price is considered as well."
— Hirsch-Houck Labs (HIGH FIDELITY Magazine)

- Advanced engineering • Finest quality components
- "Beginner-Tested," easy step-by-step instructions
- LIFETIME service & calibration guarantee at nominal cost
- IN STOCK — compare, then take home any EICO equipment — right "off the shelf"— from 1500 neighborhood EICO dealers.

Stereo Amplifier-Preamplifier HF81

Stereo Preamplifier HF85

70W Stereo Power Amplifier HF87
28W Stereo Power Amplifier HF86

FM Tuner HFT90
AM Tuner HFT94
FM/AM Tuner HFT 92

Stereo Integrated Amplifier AF4

12W Mono Integrated Amplifier HF12
Other Mono Integrated Amplifiers:
50, 30, & 20W (use 2 for stereo)

2-Way Bookshelf Speaker System HFS1
3-Way Speaker System HFS3
2-Way Speaker System HFS5

Over 1 MILLION EICO instruments in use throughout the world.

Add 5% in the West.

HF81 Stereo Amplifier-Preamplifier selects, amplifies, controls any stereo source & feeds it thru self-contained dual 14W amplifiers to a pair of speakers. Provides 28W monophonically. Ganged level controls, separate balance control, independent bass & treble controls for each channel. Identical Williamson-type, push-pull EL84 power amplifiers. **"Excellent"** — SATURDAY REVIEW; HI-FI MUSIC AT HOME. **"Outstanding quality . . . extremely versatile."**—ELECTRONICS WORLD LAB-TESTED. **Kit $69.95. Wired $109.95.** Includes cover.

HF85 Stereo Preamplifier is a complete, master stereo preamplifier-control unit, self-powered for flexibility & to avoid power-supply problems. Distortion borders on unmeasurable even at high output levels. Level, bass, & treble controls independent for each channel or ganged for both channels. Inputs for phono, tape head, mike, AM, FM, & FM-multiplex. One each auxiliary A & B input in each channel. Switched-in loudness compensator. **"Extreme flexibility . . . a bargain."**— HI-FI REVIEW. **Kit $39.95. Wired $64.95.** Includes cover.

New HF87 70-Watt Stereo Power Amplifier: Dual 35W power amplifiers of the highest quality. Uses top-quality output transformers for undistorted response across the entire audio range **at full power** to provide utmost clarity on full orchestra & organ. IM distortion 1% at 70W, harmonic distortion less than 1% from 20 to 20,000 cps within 1 db of 70W. Ultra-linear connected EL34 output stages & surgistor-protected silicon diode rectifier power supply. Selector switch chooses mono or stereo service; 4, 8, 16, and 32 ohm speaker taps, input level controls; basic sensitivity 0.38 volts. Without exaggeration, one of the very finest stereo amplifiers available regardless of price. Use with self-powered stereo preamplifier-control unit (HF85 recommended). **Kit $74.95. Wired $114.95.**

HF86 28W Stereo Power Amplifier **Kit $43.95. Wired $74.95.**

FM Tuner HFT90: Prewired, prealigned, temperature-compensated "front end" is drift-free. Prewired exclusive precision **eye-tronic®** traveling tuning indicator. Sensitivity: 1.5 uv for 20 db quieting; 2.5 uv for 30 db quieting, full limiting from 25 uv. IF bandwidth 260 kc at 6 db points. Both cathode follower & FM-multiplex stereo outputs, prevent obsolescence. Very low distortion. **"One of the best buys in high fidelity kits."** — AUDIOCRAFT. **Kit $39.95*. Wired $65.95*. Cover $3.95.** *Less cover, F.E.T. Incl.

New AM Tuner HFT94. Matches HFT90. Selects "hi-fi" wide (20c – 9kc @ —3 db) or weak-station narrow (20c–5kc @ —3 db) bandpass. Tuned RF stage for high selectivity & sensitivity; precision **eye-tronic®** tuning. **Kit $39.95. Wired $65.95.** Incl. Cover & F.E.T.

New FM/AM tuner HFT92 combines the renowned EICO HFT90 tuner with excellent AM tuning facilities. **Kit $59.95. Wired $94.95.** Includes covers and F.E.T.

New AF-4 Stereo Amplifier provides clean 4W per channel or 8W total output. Inputs for ceramic/crystal stereo pick-ups, AM-FM stereo, FM-multi stereo. 6-position stereo/mono selector. Clutch-concentric level & tone controls. Use with a pair of HFS-5 Speaker Systems for good quality, low-cost stereo. **Kit $38.95. Wired $64.95.**

HF12 Mono Integrated Amplifier provides complete "front-end" facilities and true high fidelity performance. Inputs for phono, tape head, TV, tuner and crystal/ceramic cartridge. Preferred variable crossover, feedback type tone control circuit. Highly stable Williamson-type power amplifier circuit. Power output: 12W continuous, 25W peak. **Kit $34.95. Wired $57.95.** Includes cover.

New HFS3 3-Way Speaker System Semi-Kit complete with factory-built ¾" veneered plywood (4 sides) cabinet. Bellows-suspension, full-inch excursion 12" woofer (22 cps res.), 8" mid-range speaker with high internal damping cone for smooth response, 3½" cone tweeter. 2¼ cu. ft. ducted-port enclosure. System Q of ½ for smoothest frequency & best transient response. 32-14,000 cps clean, useful response. 16 ohms impedance. HWD: 26½", 13⅞",14⅜". Unfinished birch **$72.50.** Walnut, mahogany or teak **$87.50.**

New HFS5 2-Way Speaker System Semi-Kit complete with factory-built ¾" veneered plywood (4 sides) cabinet. Bellows-suspension, ⅝" excursion, 8" woofer (45 cps res.), & 3½" cone tweeter. 1¼ cu. ft. ducted-port enclosure. System Q of ½ for smoothest frequency & best transient response. 45-14,000 cps clean, useful response. HWD: 24", 12½", 10½". Unfinished birch **$47.50.** Walnut, mahogany or teak **$59.50.**

HFS1 Bookshelf Speaker System complete with factory-built cabinet. Jensen 8" woofer, matching Jensen compression-driver exponential horn tweeter. Smooth clean bass; crisp extended highs. 70-12,000 cps range. 8 ohms. HWD: 23" x 11" x 9". Price **$39.95.**

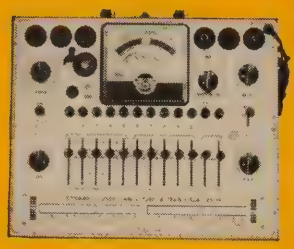
HFS2 Omni-Directional Speaker System (not illus.) HWD: 36", 15¼", 11½". **"Eminently musical"** — HIGH FIDELITY. **"Fine for stereo"** — MODERN HI-FI. Completely factory-built. Mahogany or walnut **$139.95.** Blond **$144.95.**

IMPORTANT NOTE: All EICO kits built according to our instructions, and all EICO factory-assembled equipment, conform to the high standards and specifications as published in EICO literature and advertisements. All EICO factory-assembled equipment is completely and meticulously hand-wired throughout — no printed circuitry; each factory-assembled unit is 100% final-tested throughout for each feature and function — no "spot" or "partial" checking. In EICO's final-test techniques, nothing is left to chance.

Fill out coupon on other side for FREE CATALOG.
Ask your dealer about EICO'S exclusive Stereo Records Bonus.

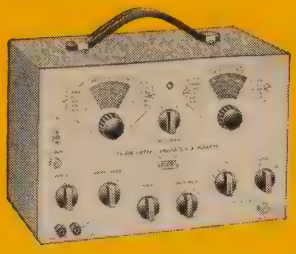
Copyright 1960 by Electronic Instr. Co., Inc., 33-00 N. Blvd. L. I. C. I, N. Y.

The specs prove it...your best buy is EICO®



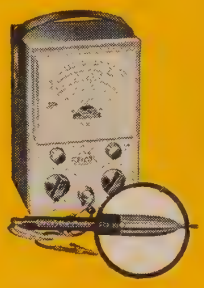
A
DYNAMIC CONDUCTANCE TUBE & TRANSISTOR TESTER #666
KIT $69.95 WIRED $109.95
Complete with steel cover & handle

B
TV-FM SWEEP GENERATOR AND MARKER #368
KIT $69.95 WIRED $119.95



C
RF SIGNAL GENERATOR #324
KIT $26.95 WIRED $39.95

D
PEAK-TO-PEAK VTVM #232 & UNIPROBE (pat. pend)
KIT $29.95
WIRED $49.95



E
COLOR & MONOCHROME DC TO 5 MC LAB & TV 5" OSCILLOSCOPE #460
KIT $79.95 WIRED $129.50
5" PUSH-PULL Oscilloscope #425:
Kit $44.95 Wired $79.95

A **Tests all receiving tubes** (picture tubes with adapter), n-p-n and p-n-p transistors. Composite indication of Gm, Gp & peak emission. Simultaneous selection of any one of 4 combinations of 3 plate voltages, 3 screen voltages, 3 ranges of continuously variable grid voltage (with 5% accurate pot.). Sensitive 200 ua meter. 10 six-position lever switches: freepoint connection of each tube pin. 10 pushbuttons: rapid insert of any tube element in leakage test circuit. Direct reading of inter-element leakage in ohms. New gear-driven rollchart. **CRA Adapter $4.50.**

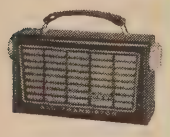
B **Entirely electronic** sweep circuit with accurately-biased increductor for excellent linearity. Extremely flat RF output. Exceptional tuning accuracy. Hum and leakage eliminated. 5 fund. sweep ranges: 3-216 mc. Variable marker range: 2-75 mc in 3 fund. bands, 60-225 mc on harmonic band. 4.5 xtal marker osc., xtal supplied. Ext. marker provision. Attenuators: Marker Size, RF Fine, RF Coarse (4-step decade). Narrow range phasing control for accurate alignment.

C **150 kc to 435 mc with ONE generator** in 6 fund. bands and 1 harmonic band! ±1.5% freq. accuracy. Colpitts RF osc. directly plate-modulated by K-follower for improved mod. Variable depth of int. mod. 0-50% by 400 cps Colpitts osc. Variable gain ext. mod. amplifier: only 3.0 v needed for 30% mod. Turret-mounted, slug-tuned coils for max. accuracy. Fine and Coarse (3-step) RF attenuators. RF output 100,000 uv, AF output to 10 v.

D **Uni-Probe — exclusive with EICO** — only 1 probe performs all functions: half-turn of probe tip selects DC or AC-Ohms. Calibration without removing from cabinet. Measure directly p-p voltage of complex & sine waves: 0-4, 14, 42, 140, 420, 1400, 4200. DC/RMS sine volts: 0-1.5, 5, 15, 50, 150, 500, 1500 (up to 30,000 v. with HVP probe, & 250 mc with PRF probe). Ohms: 0.2 ohms to 1000 megs. 4½" meter, can't-burn-out circuit. 7 non-skip ranges on every function. Zero center.

E **Features DC amplifiers!** Flat from DC to 4.5 mc, usable to 10 mc. Vert. Sens.: 25 mv/in.; input Z 3 megs; direct-coupled & push-pull throughout. 4-step freq.-compensated attenuator up to 1000:1. Sweep: perfectly linear 10 cps — 100 kc (ext. cap. for range to 1 cps). Pre-set TV V & H positions. Auto sync. lim. & ampl. Direct or cap. coupling; bal. or unbal. inputs; edge-lit engraved lucite screen with dimmer control; plus many more outstanding features.

FREE CATALOG shows you HOW TO SAVE 50% on 65 models of top quality professional test equipment. MAIL COUPON NOW!

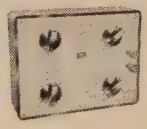


New Transistor Portable Radio RA-6
Kit $29.95
Wired $49.95
Incl. F.E.T.; less 9V batt. Prealigned RF, IF xfmrs; push-pull audio; 6" spkr.

*PAT. PEND.

NEW Power & Bias Supply for Transistorized Eqpt. #1020 *
Kit $19.95
Wired $27.95

NEW Tube & CRT Fil. Tester #612
Kit $3.95
Wired $5.95
Fast-checks radio/TV tubes, pilot lamps, etc.



Series/Parallel R-C Combination Box #1140
Kit $13.95
Wired $19.95

Tube Tester #625
Kit $34.95
Wired $49.95
- tests 600 mil series string type tubes
- illuminated roll-chart

Pix Tube Test Adapter..... $4.50

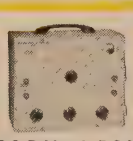
6V & 12V Battery Eliminator & Charger #1050
Kit $29.95
Wired $38.95
Extra-filtered for transistor equipt.
#1060 Kit $38.95
Wired $47.95

20,000 Ohms/Volt V-O-M #565
Kit $24.95
Wired $29.95

1000 Ohms/Volt V-O-M #536
Kit $12.90
Wired $14.90

EICO
33-00 Northern Blvd. L.I.C. 1, N.Y.
Add 5% in the West. © 1959

TURN PAGE FOR MORE EICO VALUES



R-C Bridge & R-C-L Comparator #950B
Kit $19.95
Wired $29.95
Reads 0.5 ohms-500 megs, 10 mmfd-5000 mfd, power factor

VTVM Probes

	Kit	Wired
Peak-to-Peak	$4.95	$6.95
RF	$3.75	$4.95
High Voltage Probe-1		$6.95
High Voltage Probe-2		$4.95
Scope Probes		
Demodulator	$3.75	$5.75
Direct	$2.75	$3.95
Low Capacity	$3.75	$5.75

EICO C-1
33-00 Northern Blvd.
L.I.C. 1, N.Y.

Show me HOW TO SAVE 50% on ☐ Test Instruments ☐ Hi-Fi ☐ Ham Gear. ☐ Send free Stereo Hi-Fi Guide. Send me FREE Catalog, name of neighborhood dealer.

Name.....

Address.....

City.....Zone.....State.....

AUTOMATION IN ELECTRONICS

. . . *Without Automation, Electronics Could Not Exist* . . .

TECHNICAL people are constantly astonished and nonplussed when they read the current polemics about automation and its supposed resulting unemployment.

To them it is clear that automation, with us since 1733, *creates more employment* in the long run. True, automation may at times cause dislocation in certain industries, but never for very long.

Let us take an outstanding example. In 1920, the American Telephone & Telegraph Co. had only manual operators, a total of 228,900 employees. There were 8,000,000 phones at that time. Then it turned to automation—the dial telephone system—eliminating nearly all hand-switchboard operators. Today, AT&T employs nearly 750,000 workers and we have over 70,000,000 phones! Such a quantity of phones could not be handled by manual operators—the phenomenal growth of the telephone industry has been made possible by electronics. But automation, instead of decreasing the number of employees, has vastly increased it. More skilled and specialized jobs have been opened up by electronics than were eliminated when electronic circuits and devices replaced operators.

A few years ago, the Corning Glass Co. with a small staff turned out hand-blown 20-inch television glass picture-tube shells for $75 apiece—*at a loss.* Then they built an automatic machine that turns out 21-inch tube shells for $9.89 each at a profit! On top of this, Corning now employs 2,000 people on TV picture-tube manufacturing—*people who have jobs that never existed before!*

It is incomprehensible that so many people fail to understand that automation means **new things** in nearly every instance. And new things mean **more work.**

Consider the following: We will mention only a single industry, radio electronics. In 1929, only 30 years ago, many of our radio receivers were still battery-operated. There were less than 11,000,000 radio sets in the United States then. In 1959, there were over 150,000,000. Most of the present-day radio tubes were unknown. Television was in the laboratory blueprint stage. Coast-to-coast broadcasting hookups were entirely via land lines. The coaxial cable still was in the future, as was microwave relay cross-country transmission. In 1929, there were no transistors, no light portable radios with concealed aerials, no pocket radios, no high fidelity, no stereo, no FM broadcasting, no magnetic recording tape, no germanium rectifiers, no proximity fuze, no radar, no guided missiles, no electronic instrument landing for airplanes, no handy-talkies, no practical two-way mobile radio, no radio astronomy, no electronic computers, no ultra-high-frequency transmissions, no atomic batteries, no solar batteries and none of several hundred other radio-electronic inventions commonplace today, but unknown a quarter-century ago.

In 1929, the radio-electronics industry was small and insignificant. Today it has achieved an annual turnover of almost $14,750,000,000! It employs over 1,000,000 people, *all* on jobs that did not exist 25 years ago.

Many of these radio-electronic items are now made by automation, with more being manufactured in this manner constantly.

Is it not elementary that only mass-produced articles—consequently only articles that are in constant demand—are turned out via automation?

An automation machine calls for a capital investment of from $50,000 to over $1,000,000. Would anyone in his right senses spend such sums if the end product to be automated did not already have a huge market?

What usually is not realized is that nearly every new and successful invention spreads out continuously, creating endless new branches like a living tree. Take the telephone, the automobile, the airplane, television — each has thousands of new facets, all creating new employment where none existed before.

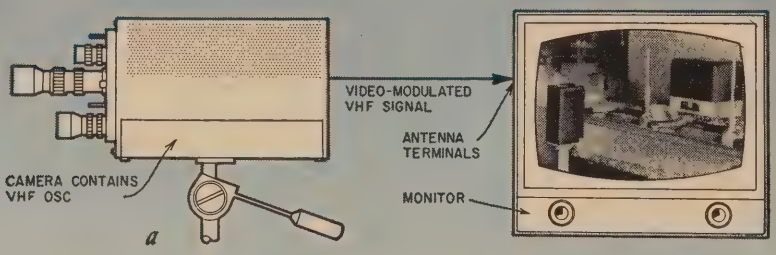
Add to this our rapidly growing population that increases demand of most items constantly. Under such pressure even automation, at times, falls behind.

Automation in our present technological age is the one absolutely necessary link to allow us to expand indefinitely. Without automation, our industry would choke from constant bottlenecks. Without it, our rapid industrial growth would be impossible despite new inventions and new devices. Today our population numbers nearly 180,000,000. By 1975, there will be 200,000,000.

Full automation by that time will supply most of our needs and give us a shorter working day with far more leisure.

—H.G.

Setting up an ITV CAMERA



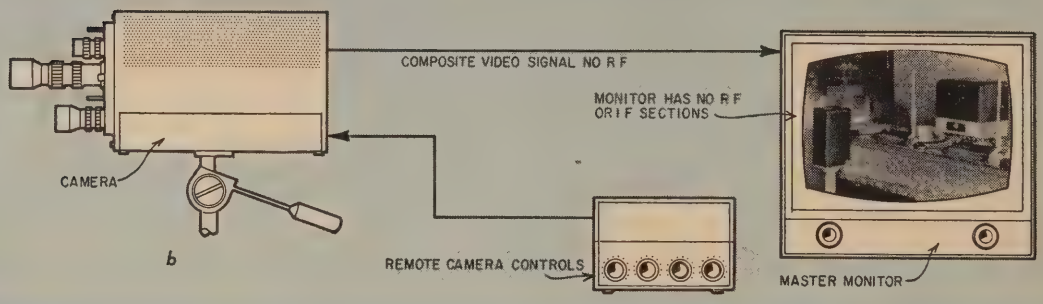


Fig. 1-a—Camera transmits vhf, monitor can be a TV receiver; b—camera output is video-frequency, camera controls may be at the master monitor.

By EDWARD M. NOLL

INDUSTRIAL television is the "seeing eye" of industrial electronics; many automatic operations depend on the remote viewing facilities of closed-circuit TV. A number of processes can be monitored from a single central control point with industrial television, and controlled from the same point with industrial electronic equipment.

New uses for closed-circuit TV systems are constantly appearing in commerce, education and business. It is doubly unfortunate that so few independent service organizations or technicians have displayed any initiative or confidence in this field. Neither industrial television nor industrial electronics has been pushed—or even welcomed—by the average technician. Yet installing and servicing industrial TV and electronic equipment is no more difficult than many regular service assignments, and certainly much simpler than most color TV receiver servicing.

An industrial TV setup must be properly installed and adjusted if the owner is to be happy with it—or even able to use it. Electronic controls, lighting and optical systems must be set precisely to insure good, reliable pictures on a long-term basis. Cameras must require a minimum of attention, and the entire system should be able to run unattended for long periods of time.

The first step in securing the best operating conditions is to adjust the pre-set controls of cameras and monitors. Correct camera adjustment is important in obtaining a high-quality picture and insuring the best life for the vidicon tube.

Two important considerations are positioning the camera and selecting an optical system suited to the duties expected. There must be enough field of view and depth of focus to include the necessary data in the picture. Lighting must be adequate to render a clear well-defined picture. Mounting positions and the intensity of the light are significant factors.

Monitor adjustment

The monitor is the first unit of an industrial television system that must be adjusted. The two most common types of closed-circuit TV systems are shown in Fig. 1. In the first one (Fig. 1-a), the monitor is a standard receiver. The television signal formed by the camera is used to modulate a high-frequency oscillator operating in the vhf television band. The vhf signal is then used as a carrier to convey the signal from the camera to the monitor. The signal is fed directly to the receiver's antenna terminals and the selector knob is set for the channel covered by the vhf oscillator.

The monitor for such an installation can be adjusted by using a signal from a standard television broadcast. Linearity and size adjustments can be made and the vertical and horizontal synchronization circuits aligned in the same manner that you would adjust a television broadcast receiver. If a standard TV broadcast cannot be received, use a bar or cross-hatch generator to tune up the monitor and viewers.

The monitor must be correctly tuned because it will be used as a standard when adjusting the camera. The camera tube requires horizontal and vertical deflection waveforms just as does the monitor. So camera linearity, size and

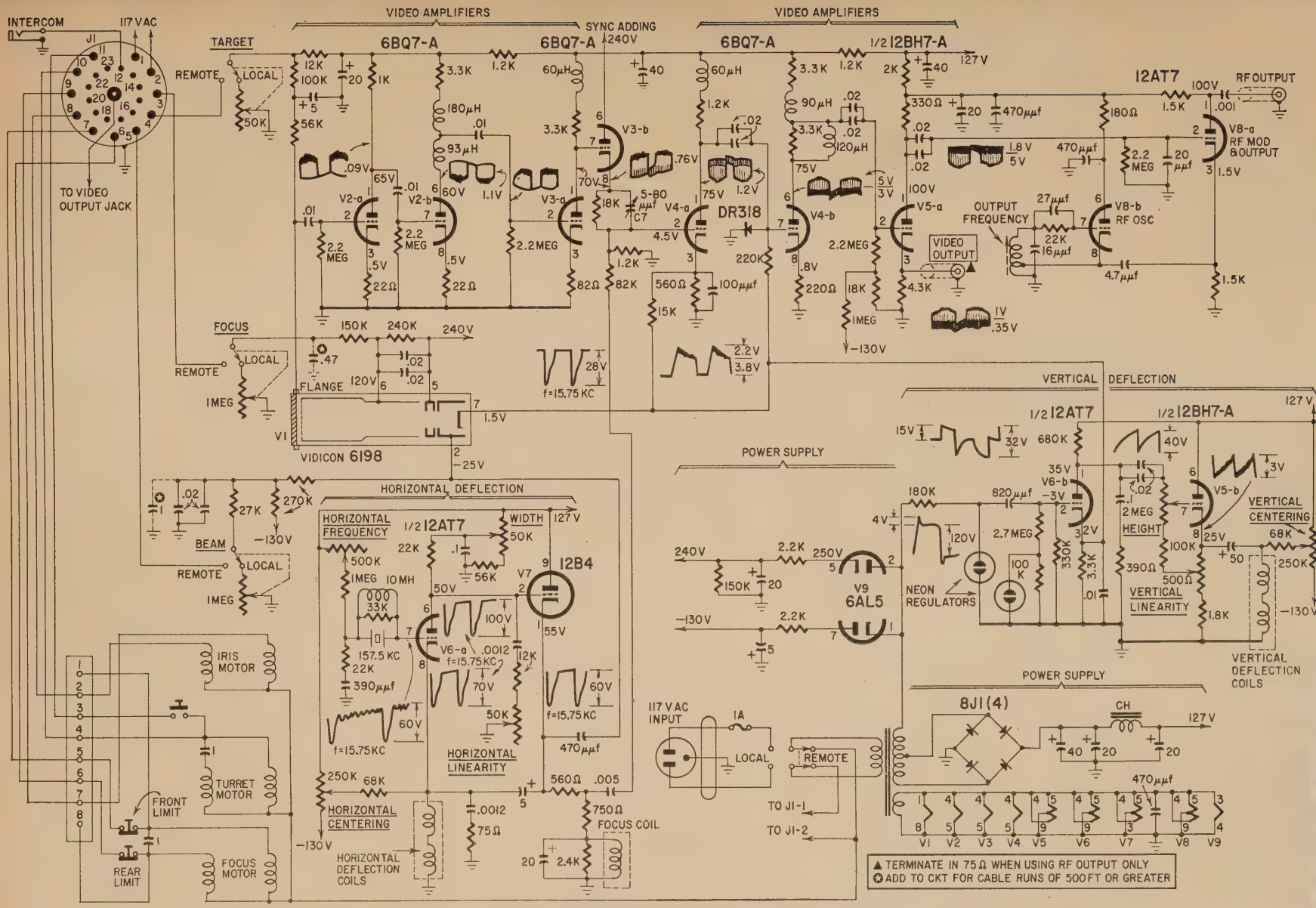


Fig. 2—Circuit of the General Precision Laboratory model PD-500 camera.

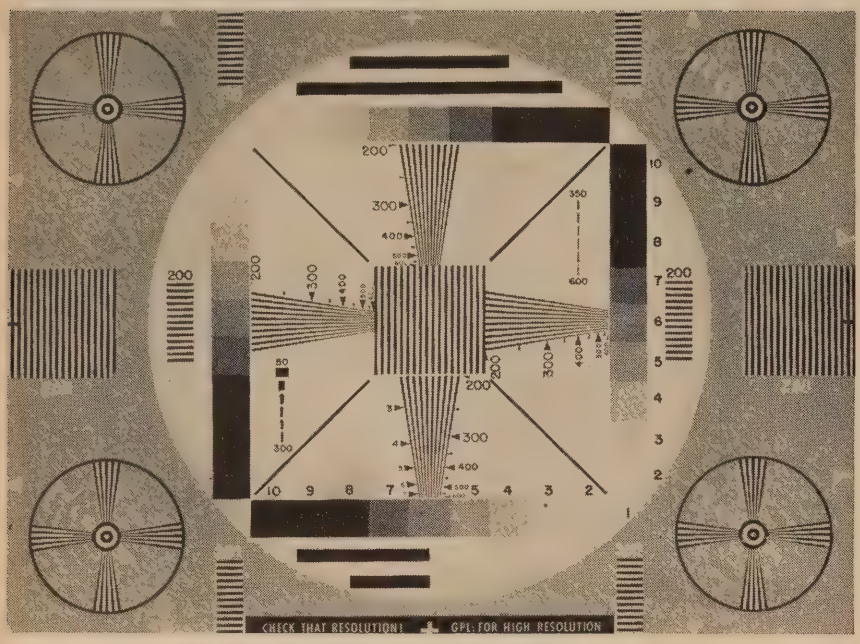


Fig. 3—Test chart used in adjusting the camera.

centering must also be adjusted. This can be done exactly only if some deflection standard is available. A correctly adjusted monitor can fill the bill.

The second arrangement (Fig. 1-b) is becoming an even more common type of industrial television installation. In it the camera controls are located at the master monitor. Thus they can be adjusted and the results observed at the master monitor. (However, there are preset camera controls that must be aligned too.) This arrangement permits mounting the camera in a fixed out-of-way or inaccessible position. It is generally much more convenient because the camera's operating characteristics can be adjusted by the person watching the picture on the master-monitor screen.

Most installations of this type do not use an rf carrier method. Instead, a composite video signal is sent over a coaxial cable to the master-monitor position. The monitor and viewers do not contain rf and if sections and the composite video signal is fed directly to the monitor's video amplifier and sync separator.

In such a system it is sometimes difficult to adjust monitor deflection correctly. The problem can be circumvented in two ways. One is to use a bar or cross-hatch generator very carefully, making certain of width and height adjustments.

The second method is to use a TV tuner and if section to receive a local television broadcast signal. The output of this tuner and if strip can then supply a composite television signal of proper amplitude to the antenna input of the master monitor. Now the television broadcast signal can be used in setting up the master monitor and viewer.

The monitor where the camera controls are located is called the master monitor or viewer. Additional monitors and viewers are called remote or slave viewers.

Camera preset adjustments

To provide as definite a procedure as possible for setting up a camera, let us consider the adjustments recommended for the General Precision Laboratory model PD-500 camera whose circuit is shown in Fig. 2. The procedures to be followed are typical for most industrial TV cameras. As cameras are shipped factory-aligned and adjusted, they can usually be put in operation and made to deliver a satisfactory picture by following the suggested operating procedure.

If picture defects appear after following the operating procedures carefully (including lens and lighting instructions), it may be necessary to adjust some of the preset controls. When camera tube or circuit replacements are made, some of the preset controls will probably need attention.

Operating procedure

1. Set the camera for local operation. Many TV cameras have facilities for either remote or local operation.

2. Set TARGET control at No. 3 on its scale (see photo at head of article). The TARGET control regulates the dc voltage applied to the signal electrode segment of the photoconductive target area.

3. Bring up the beam voltage slowly until a picture appears. The BEAM control regulates the negative bias supply to the control grid of the gun section of the vidicon camera tube.

4. Focus the picture carefully. It will rotate slightly as the adjustment is made and, if the camera is operating normally, the picture will come into focus when it is exactly upright. The ELEC FOCUS control regulates the dc voltage applied to the wall electrode of the vidicon camera tube. If the picture does not come into focus, check both the monitor focus and the optical focusing of the lens system.

5. If a picture did not appear when beam voltage was increased, move the TARGET control to the next highest setting, improving its sensitivity. Repeat steps 3, 4 and 5 until a picture does appear.

Proper settings of beam and target voltages are important. Generally, the minimum possible target voltage required to produce a good-quality picture should be used. Although increasing the target voltage does improve sensitivity, there is a greater tendency toward image retention or stickiness. (If the camera is panned or tilted or a new lens switched into position quickly, an impression of the previous scene will persist for a short time.) Also, with stickiness it is more difficult to differentiate a fast-moving object, as an impression of the motion will hang on in the reproduced picture.

Under certain circumstances, a high target voltage can produce image burn-in—an image of the scene being televised under improper operating conditions will make an impression in the target surface which will persist for a long period of time and, if very serious, for the life of the tube. It is always advisable to use as much light as feasible and the widest lens aperture that can provide the proper depth of field. In this way the TARGET control can be set to a minimum value.

The BEAM control influences the ability of the camera tube to resolve the brightest portions of the scene and produce a picture with a good contrast ratio. It is generally turned up until the bright portions or highlights of the scene can be well differentiated. A good operating procedure is to find the lowest target voltage that will permit the BEAM control to resolve or wipe clean the brightest areas of the scene.

Use only enough beam current to resolve the highlights. When the top of the picture flickers, it often indicates that the beam setting is too high and the beam current excessive. If the picture becomes twisted or distorted or begins to roll vertically, it is often an indication of hum being introduced because of too high a target or beam setting. Dark lines at the top of the picture often imply too high a target setting.

If a camera must be used to view both brightly illuminated and dull subjects, vary the target voltage only. Set the BEAM control for the brightest subject and leave it there. Now you can lower the target voltage for bright scenes and increase it for low ambient lighting conditions and dull subjects.

If remote operation is included, the same operating procedure should be followed, using the remote controls with the camera set on remote. To summarize,

the target setting should be set to the lowest value that will render an adequate picture. The more lighting, the lower this setting can be. Beam setting in turn depends on target setting—a higher target setting requires a higher beam setting. The BEAM control too should be operated as low as possible and at a setting that will just resolve the brightest portions of the picture.

If lighting levels are very low (under 15 or 20 foot-candles), the target must be operated at near maximum. Under these conditions there will be a great tendency for the highlights to stick with scene motion and some bright flare may exist at the edges of the picture. On the other hand, if TARGET and BEAM controls are set too low, picture contrast is lowered. Although contrast can be corrected to some extent by increasing the overall video gain of the system, noise content is also increased. Therefore, beam and target settings should be high enough to render a noise-free picture.

If a camera is used frequently, it is generally advisable to let it operate continuously if light levels and subjects do not change radically. The life of the camera tube and other vacuum tubes in the unit is usually longer because there is no frequent heating and cooling of the tube electrodes and no voltage surges due to turning equipment on or off.

Scanning adjustments

An important consideration in the operation of the vidicon camera tube is to make certain that the useful area of the target surface is scanned. When the target surface is not scanned fully, a permanent impression of the smaller raster section is burned into the vidicon target. Consequently, when normal scanning is restored, a burnt-in impression of the smaller area will appear in the reproduced picture. Furthermore, if the complete area is not scanned, full resolution cannot be realized from the vidicon camera tube. When the target surface is being scanned fully, the actual corners of the target barely appear in the picture on the monitor or can be made to appear with only a very slight adjustment of the vertical and horizontal centering controls at the rear of the camera.

A test chart such as the one in Fig. 3 is generally used when adjusting vidicon scanning. Such a chart not only provides a check of scanning, but also resolution, contrast and focus. For a general check of scanning linearity, check the trueness of the large center circle and the four corner circles. More specifically, the vertical sweep linearity can be judged by comparing the spacing of the short horizontal bars at both top and bottom of the chart with those of the middle bars. Horizontal linearity can be checked in a similar manner. Just compare the vertical bar spacing at each side with the center bar spacing. A true aspect ratio will not only reproduce the center circle faithfully, but the pattern formed by the gray scale will produce a perfect square as well.

To use the chart most effectively, a linear and properly adjusted monitor is needed. The chart, according to the instructions included with the camera, should be positioned at a prescribed distance from the camera with the proper lens in position and the camera directed toward the chart perpendicular and dead center. Then the camera can be set to use the full area of the target surface.

Scanning adjustment procedure:

▸ With the 1-inch lens in position, the test pattern provided should be mounted 14 inches from the end of the lens. Now proper scanning will exactly cover the whole chart. If the 2-inch lens is used, the chart should be mounted 28 inches from the lens edge. Be certain that the camera is positioned so its axis is lined up with the center of the chart. The optical focus should be adjusted for 14 inches or 28 inches, as required.

▸ Adjust the VERTICAL LINEARITY and HEIGHT controls for a full-size and linear picture vertically. The VERTICAL LINEARITY and HEIGHT controls are both in the vertical output stage.

▸ The WIDTH, HORIZONTAL LINEARITY and HORIZONTAL FREQUENCY controls interact and sometimes influence proper focus. If there appears to be a complete misadjustment, all three controls should be set to their mid-positions. Adjust the HORIZONTAL FREQUENCY control for proper lock-in of the picture on the monitor screen. Next adjust the WIDTH and HORIZONTAL LINEARITY controls for a full-size and linear picture in the horizontal direction. Then readjust horizontal frequency and focus for the best possible picture. The horizontal controls are in the camera's two-stage horizontal deflection pulse generator, tubes V6-a and V7.

Some interaction between adjustments should be expected because of the multiple functions of the horizontal and vertical deflection waveform generators. In these two stages all the necessary waveforms and pulses for the television system are formed. For example, the horizontal deflection system generates two other pulses in addition to the deflection waveform required by the horizontal deflection coils. Horizontal blanking pulses are formed as well as horizontal sync-blanking pulses that are added to the video information and conveyed to the monitor. At each monitor these pulses blank the picture tube and synchronize the horizontal deflection system. The vertical deflection generator performs the same function in terms of vertical deflection, blanking and sync-blanking.

▸ The centering controls should be adjusted to just pull the edges of the target out of the picture as viewed on the monitor. If this cannot be done, it sometimes indicates that a shield or iron wire wrapping has become permanently magnetized.

▸ If a tilted picture appears on the monitor screen, orient the camera's deflection yoke until the picture is straight.

High-peaker and cable compensation

The high-peaker stage of the camera's video amplifier compensates for the loss of highs at the output of the camera tube. The high-peaker has a rising gain characteristic with frequency. A control generally associated with this stage permits a more precise control over the bandwidth characteristic of the television system. Hence it is possible to make corrections for other frequency disturbances, both high and low, with the control facilities of a high-peaker. Usually the high-peaker is adjusted to get a picture with maximum possible resolution without the appearance of echoes or repeats in the picture information. These transients show up as vertical repeats behind abrupt changes in scene brightness.

In the GPL PD-500 camera, capacitor C7 and tube V3-b compensate for the influence of cable length between camera and viewer. The capacitor is adjusted for minimum streaking and smear in the reproduced picture.

The quality of picture in a closed-circuit system is always surprising, considering the few stages and simplicity of the units employed. In difficult television pickup locations, don't expect reproduction comparable to that of a television broadcast station. Remember, television studios are illuminated by batteries of lights and the television signal is developed and corrected in elaborate amplifier and control systems. To obtain a good-quality picture in industrial television application, the camera must be adjusted carefully and diligent attention must be given to proper lighting, lens arrangement and mounting position. END

"I think I'll get a decade resistor kit. That means it's guaranteed for 10 years, doesn't it?"

Pulsed electric currents discourage undesirable fish — save valuable ones

Electronics Goes Fishing...

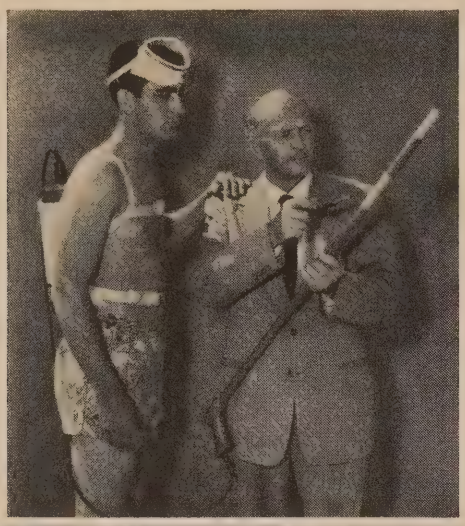


Fig. 1—The shark repeller gives dangerous fish the desire to go elsewhere for lunch.

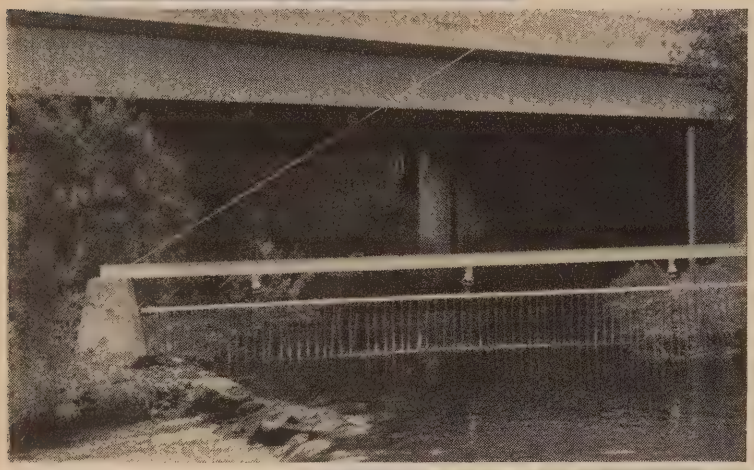


Fig. 2—Electrode system of an electronic fish screen at the intake for an irrigation district.

Fig. 3—These two metal plates were immersed in salt water for 6 months. Lower specimen has heavy crust of corrosion and algae. Upper specimen, used as a negative electrode in pulsed-current setup has only a uniform grayish coating which prevents corrosion.

By S. M. MILANOWSKI

WITH the right electronic equipment, you can not only catch fish but you can be sure of getting the types and sizes you want. Also, you can avoid or prevent the needless destruction of valuable marine life by killing or rendering harmless the more voracious species, such as sharks.

It's mainly a matter of knowing how and where to use high-voltage current which is pulsed somewhat like the output of a radar transmitter.

The shark repeller

A recent, yet relatively simple, example of electronic fish-control equipment is the shark repeller shown in Fig. 1. Designed for use by skin divers and people aboard survival rafts at sea, it repels any dangerous species of marine life that may be encountered by giving the fish a series of 500-volt shocks—each similar to the jolt you get after sliding across the seat of a car and touching a metal part. These shocks probably couldn't kill anything larger than a microbe, but they give unimaginative creatures like sharks and moray eels a sudden desire to go elsewhere for lunch.

Power for the shark repeller comes from a battery-powered unit (strapped to the back of the diver in Fig. 1) with a trigger type switch which is manually depressed. A person using the device with reasonable care will receive none of the high-voltage output because the equipment is well insulated and has a probe which is literally an antenna that produces an elliptical zone of electrified water well away from the operator's body.

Electronic fish screens

Fundamentally, the shark repeller is a miniature version of an electronic fish screen.

Fig. 2 shows the cast-iron electrode system of an electronic fish screen designed to keep fish away from the intakes of an irrigation district and a municipal reservoir. An ordinary metal barrier or "trash rack" couldn't serve the purpose of these screens, because it

would soon be clogged up with fish that tried to swim through it. The electrodes could of course be charged with raw ac or dc, but this would literally create a stink by killing fish—and perhaps a few humans.

Because the 1,000-volt output of the electrodes is pulsed very slowly, an invisible zone of electrified water is briefly and repeatedly produced in front of each intake. This zone ranges from 10 to 20 feet from the electrodes and is parallel to the flow of water (since fish ordinarily travel lengthwise with water currents and should receive optimal shocks in this position). Of course, the further from the electrodes the weaker the field.

Small fish, having the smallest surface areas, can swim closer to the electrodes than large fish, without experiencing discomfort. However, any fish that comes too close receives a jolt strong enough to make him turn away from the electrodes.

Selective barriers

As various species of fish have differing reactions to pulsed current, electronic equipment can be used for other purposes. For instance, let's consider the case of the sea lamprey and the trout.

As the reader may recall, the sea lamprey is a bloodthirsty killer which invaded the Great Lakes region a few years ago and virtually annihilated trout which had previously brought commercial fishermen an estimated $8,000,000 a year. (In Lake Michigan alone, the catch dropped from more than 5,500,000 pounds in 1946 to a mere 402 pounds in 1953.) Consequently, researchers decided to try eradicating sea lampreys in the Great Lakes with an electronic technique that had been used successfully in fish hatcheries.

The equipment produces pulses at a rate which allows fast-swimming trout to dart through the electronic-screen area while the current is off, and yet makes life painful for slow-moving lampreys, when the two species head toward their spawning grounds. This worked out better than anybody expected because lampreys whose mating instincts are aroused ignore the pain caused by the pulsed current until they are electrocuted.

A simple relay circuit controls the 1,000-volt pulses fed to the electrodes. Circuits of this type may use 3–600 watts of power to deliver 500–1,000-volt pulses at a rate of usually less than 10 per second—depending on the conductivity of the water, the area to be electrified and the species of fish being dealt with.

The control circuit usually uses two relays. One controls the 1,000-volt output while the other controls the thyratron that keys the output relay. The thyratron control relay is placed in the grid circuit and is set up so that when it is energized the thyratron fires, closing the pulsing relay. To assure a short pulse the grid relay has two sets of contacts—one set normally open, the other normally closed—so arranged the open contacts close before the closed contacts open. When this relay is activated, the normally open contacts close, firing the thyratron. The normally closed contacts then open, cutting off the thyratron and the 1,000-volt pulse.

Other uses

The low-cost metal electrodes do not undergo electrolysis when charged with pulsed current and if their polarity is reversed occasionally, they usually acquire protective coatings which actually prevent corrosion.

This occurs because the high-voltage current flowing between electrodes electrifies minerals suspended in water and deposits them on negatively charged metal surfaces. Because such deposits take place more rapidly in salt water than in fresh, naval officials and commercial shipowners have been trying to find out whether pulsed current can be used to keep the hulls of seagoing vessels from corroding and then accumulating large quantities of algae and barnacles (see Fig. 3).

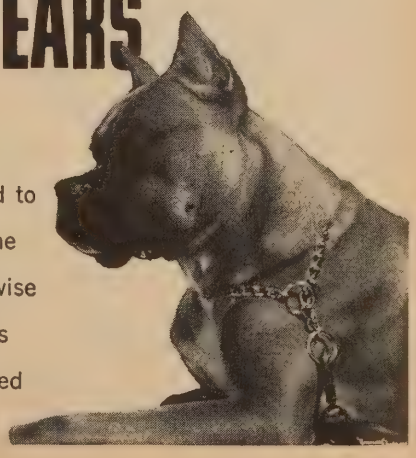
By greatly increasing the weight of a ship, algae and barnacles reduce operating efficiency to a point where the vessel must be drydocked (so its hull can be cleaned and refinished) every year or two. If electronic equipment can be used to maintain a protective finish on a metal hull as it does on the metal electrodes for a fish screen, the cost of operating naval and commercial ships may be lowered many millions of dollars annually.

It has also been suggested that a refinement of the pulsed-current concept might make it practical to recover valuable minerals—such as gold and silver—which are known to be suspended in ocean water. This would necessitate the use of electrical or magnetic plates, each of which could collect a given mineral in accordance with the electromagnetic properties of the desired material in an electrified condition. END

PROTECTING YOU ... FOR FOUR YEARS

Radio-Electronics
tube advertising policy is four years old this month.

Since January 1956 we have refused to accept mail order tube advertising which did not specifically state that the tubes offered for sale were new and unused—or seconds, rejects, or otherwise substandard if that was the case. This has cost us thousands of dollars in advertising revenue—but it has protected you from being disappointed and defrauded. We think it's worth it.



PHOTOELECTRIC REGISTER CONTROLS ...how they work

Cutting, punching, imprinting, and embossing are vital parts of many industries and the electronic controls that keep these devices working accurately can become a profitable source of income for the aggressive independent service shop

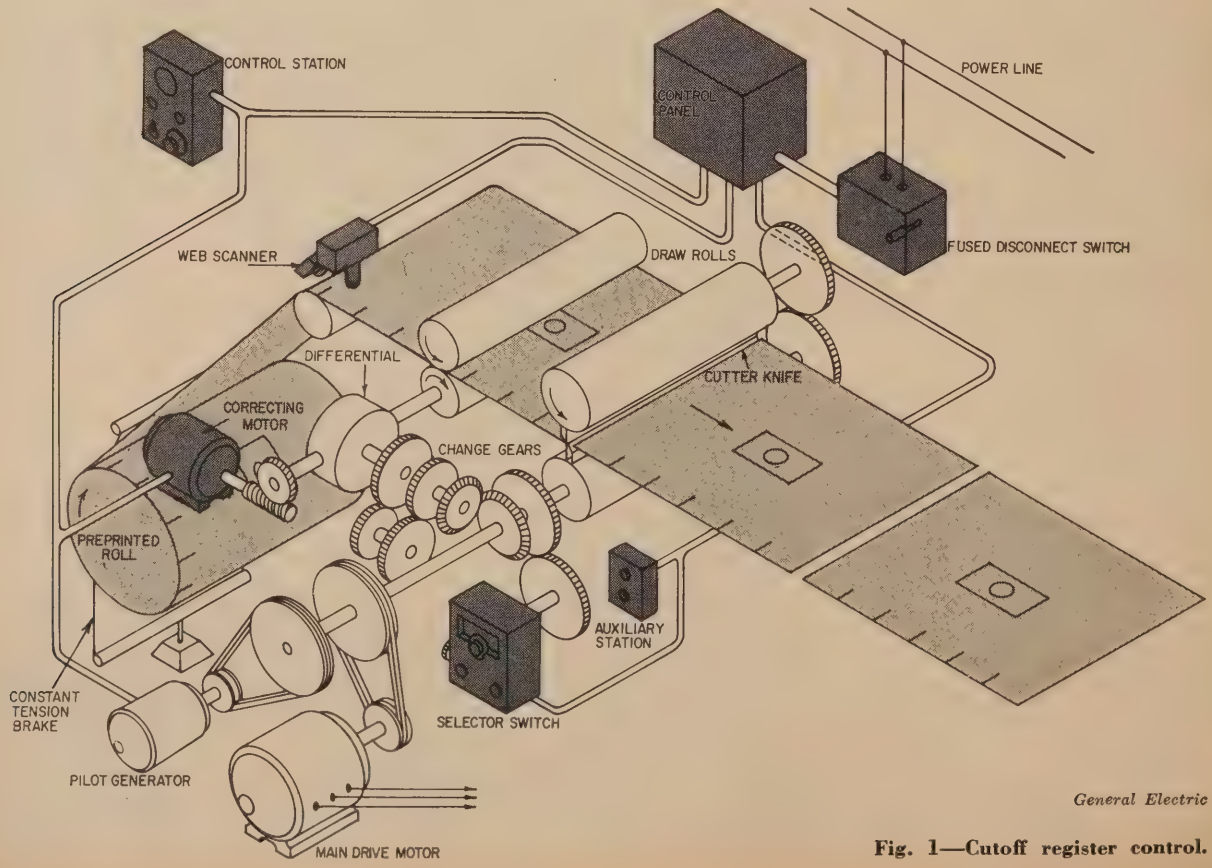
By ALLAN LYTEL

WHEREVER rolls of material are cut to sheet size, imprinted, punched or embossed —whether in a steel mill, a paper plant or a printing house—photoelectric controls make sure the cuts, printing, holes or embossing come out in the right place.

Wherever a continuous strip of material (or *web*) is wound into a roll, photoelectric controls help keep the roll's edges smooth and even. These electronic devices can be and are kept in good working order by electronic technicians. Any technician can repair or maintain one of these systems if he knows how it works. Let's examine some of the types that are in use.

A correction type of register control made by G-E is shown in Fig. 1. It is used on a cutting machine and requires a roll of paper (or other material) preprinted with register marks that trigger the web scanner controlling the cutter knife. Each cut produces a sheet of paper of the proper length. The system has built-in correction to compensate for errors in the machine or changes in the roll or web caused by stretching or shrinking.

This may seem foolishly complex but there is more to the cutting than you might think. Suppose the machine were cutting pages from a preprinted web—a seemingly uncritical operation. What difference does an error of .01 inch in



General Electric

Fig. 1—Cutoff register control.

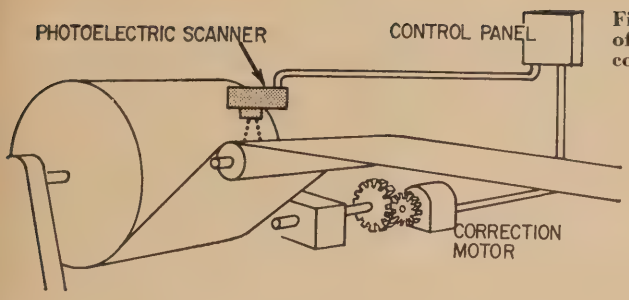
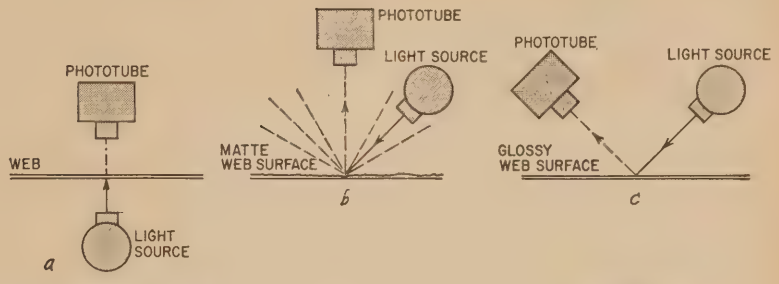


Fig. 2—Basic operation of G-E side register control systems.

Fig. 3—Three light-source and phototube-pickup arrangements; a—transmitted light scanning; b—diffuse reflected light scanning; c—specular reflected light scannning.



a 3-foot length of paper make? None, if you are cutting only a couple of sheets. But when many thousands of pieces are cut, and the error is cumulative, you have a 1-inch error after 100 pages and an error of 10 inches after only 1,000 pieces. Before you know it you are cutting the page in the middle instead of at the end.

The error control system does four things:

- The web scanner detects the relative position of the register marks.
- The selector switch detects the relative position of the cutter blade.
- The control panel circuitry compares these positions to determine their relationship.
- The correcting motor adjusts for any difference between the actual and the proper cutting position.

Side register controls

In operations such as paper printing or slitting, you end up with improper printing and wasted materials if the web moves sideways. Some system for keeping the paper in line is needed.

Such a system is shown in Fig. 2. The edges of the web are "seen" by a photoelectric tube which controls the web's side-to-side movement. The controls can be at the beginning of the process (where the web enters the machine), at the end of the process (where the web leaves it) or at some intermediate point.

To control sideways motion, a web scanner is needed. Such scanners fall into two groups—static and dynamic. The static scanner "watches" the web's edge and produces a steady signal to indicate the position of the web at all times. A dynamic scanner produces a signal only when a register mark passes the light beam. Dynamic scanners are commonly used as cutoff register controls to cut material to proper lengths.

Light can be transmitted through the web, as in Fig. 3-a, or reflected in a diffused manner, as in Fig. 3-b, where the surface is rough, or scanning can be specular as in Fig. 3-c.

The light source includes a lens system to focus the light on the desired position. The phototube is set to pick up the desired light according to the type of scanning. Phototubes are made with several color sensitivities, but the most important two for register controls are the red-sensitive S-1 and the

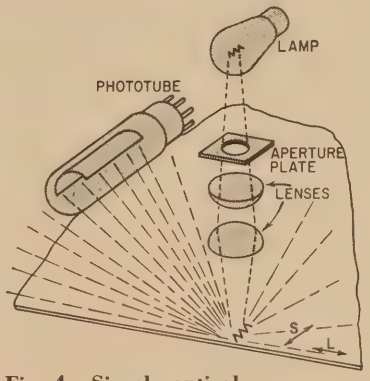


Fig. 4—Simple optical system for small photoelectric web scanners.

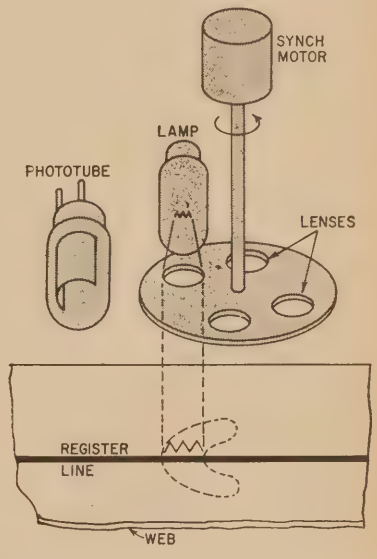


Fig. 5—Rotary lens web scanner.

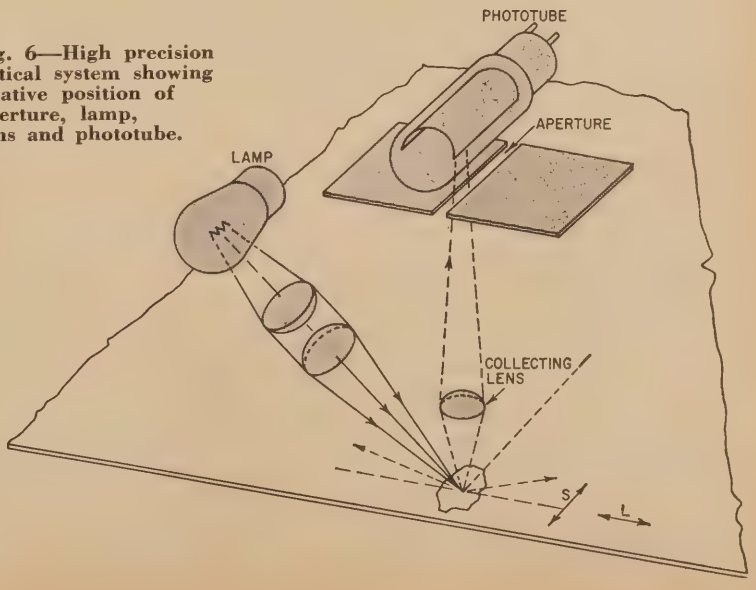


Fig. 6—High precision optical system showing relative position of aperture, lamp, lens and phototube.

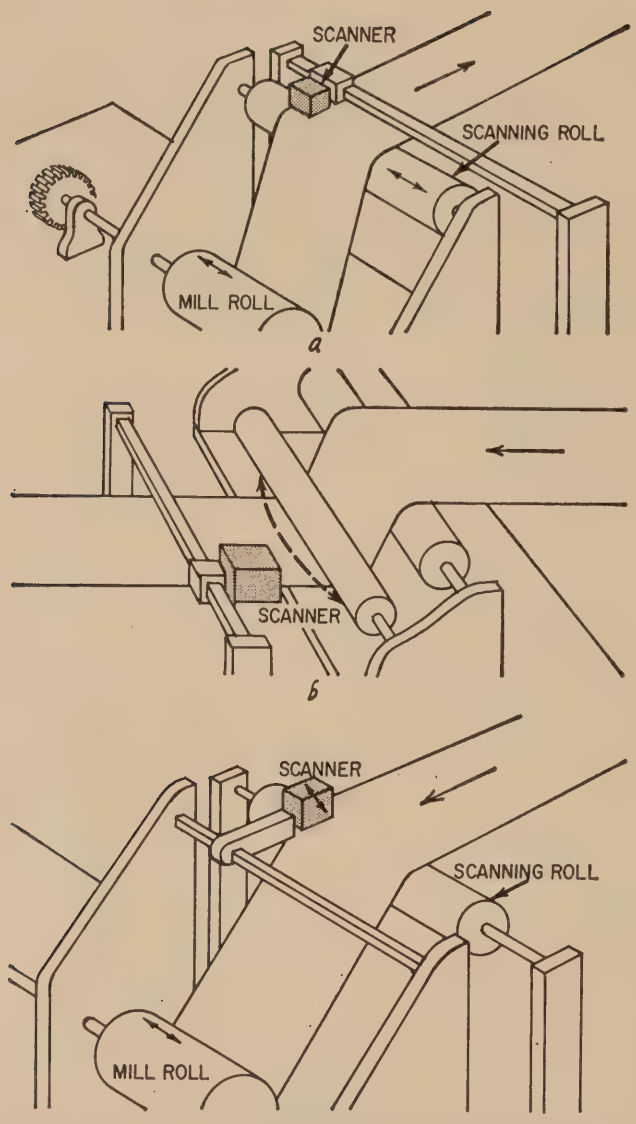


Fig. 7—Three kinds of side register controls: a—pay-off—for guiding a web entering a processing machine; b—mid-line—for guiding a web in the middle of a processing line; c—wind-up—for guiding a web at the exit end of a processing machine.

blue-sensitive S-4. These types include the red-sensitive 930, 868/PJ23 and the blue-sensitive IP39, 934 and 441. The preferred, most sensitive types are the IP40, 927, 918 and 927 (red) and 5581, 5583 and IP37 (blue).

The simple optical system used in the General Electric 3S7515-PS102 is shown in Fig. 4. The phototube is placed as close to the web as possible. As the web moves, scanning can be either sidewise (S) or lengthwise (L).

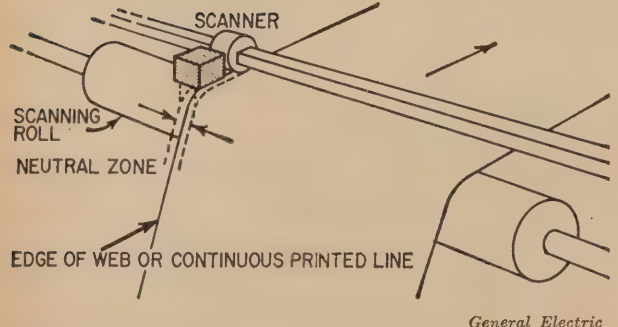
In the more complex system of Fig. 5, a rotary lens system does the scanning. A spot image from the light source is swept across the register line. The pulse from the phototube is phase-compared with the driving signal for the synchronous motor. The difference, if any, indicates the amount of misregister and is fed back as a correction signal. This is used in the General Electric CR7515-P201.

A high-precision system is shown in Fig. 6. A lens system forms a very bright spot of light which a collecting lens system directs to the tube. A variable aperture controls the light falling on the phototube. A position on the web can be detected to within .001 inch and stray light cannot affect this system. It is used in General Electric type CR7515-P202.

There are three ways to use side register controls. They are shown in Fig. 7. A "payoff" control is used when a web enters a machine (Fig. 7-a), a "mid-line" control in the middle of a process (Fig. 7-b) and a "windup" control at the end of a process (Fig. 7-c).

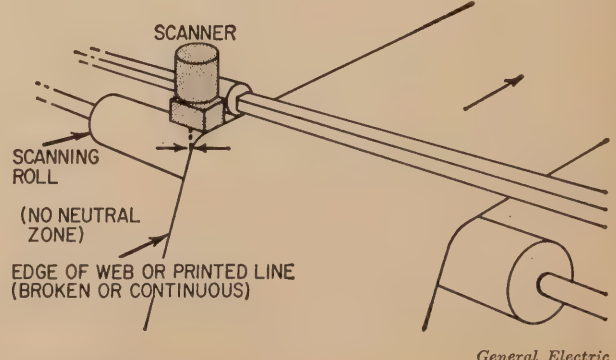
There are also two *types* of controls: Two-point and proportional. A two-point side register controls the web scanner (3S7515-PS102) discussed earlier. Where the rate of side motion of the web is moderate this system is effective. The edge of the web is normally used as an indication for the phototube, but a printed line will also serve. The control is an on–off system which provides adjustment only when the error exceeds preset limits. There is no control as long as the web is in the neutral zone (Fig. 8).

A proportional control (Fig. 9) has no neutral zone. Instead, it uses the



General Electric

Fig. 8—Two-point side register control system.



General Electric

Fig. 9—Proportional side control system.

CR7515-P201 rotary lens scanner. Correction rates go up to 100 inches per minute with an accuracy up to ±.010 inch of web displacement. The control can follow the edge of a web or printed lines, which can be solid, broken, black or colored.

The two-position control has a small differential over which it operates. The differential is defined as the difference between the upper and lower limits. Midway between them is the point to which the control is set. In a proportional control, the sped of the correction is proportional to the amount of error.

Side register control use vacuum-tube circuits which are related to radio. The circuit in Fig. 10 is a simplified drawing of one type of side register control. Because it must respond to slow changes in web motion from side to side, the tubes are direct-coupled. At some position, as in the original adjustment, the web register is correct. Then the light falling on phototube V1 is balanced by R5 and R14 so there is equal output from V5 and V6 and the correction motor does not move.

If the web moves to one side, more light falls on V1 and current increases, creating a greater voltage across R1, which increases the positive voltage on V2's grid. A voltage divider (R3, R4, R5) across the regulated supply voltage provides several reference potentials. R5 is used to vary V2's cathode voltage.

When V2's grid becomes more positive, the tube conducts more, lowering its plate voltage, and, since V2 is direct-coupled to V3, its grid voltage goes down. R2 sets the amount of this change. V3 and V4 form a phase-inversion circuit: as V3's grid goes less positive, its plate current drops. This increases the plate voltage which makes V5's grid more positive, increasing V5's plate current.

At the same time, the lowered cathode current (and resulting cathode voltage) through R6 also affects V4. This tube has a constant positive grid voltage, obtained from the voltage divider, so the lowered cathode voltage increases the plate current. This lowers V4's plate voltage and V6's grid voltage, decreasing V6's plate current.

Now V5 and V6 are out of phase. Each one's plate current becomes a source of driving power for the correction motor through a generator system. There is more current through forward winding F and less through reverse winding R, and the correction motor goes forward to correct for the original error of web motion. We get reverse action when less light hits the phototube (an error in the opposite sense) and the correction motor reverses and goes in the other direction.

CR7515-S118 side register control

This side register control equipment uses a continuous line or edge of a moving web of material to maintain the lateral position of the web. The photoelectric scanning head detects deviations of the material from its "on-center"

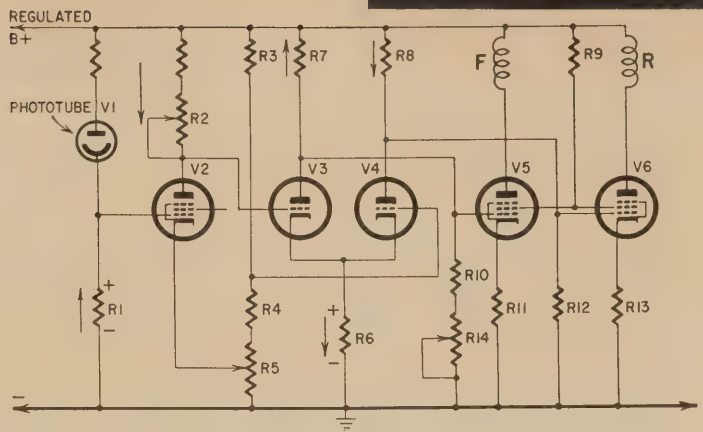


Fig. 10—Circuit of side register control CR7505-S119.

position under the scanning head. One of two telephone type relays on the control panel, depending on the direction of lateral deviation, is triggered by the scanner signal. Whenever the material is in register (on center), both relays are de-energized (Fig. 11). If the material moves to one side, more light reaches the phototube and one of the relays (2CR) closes. This relay stays closed until the deviation is corrected. If the material moves the other way, the amount of light decreases and the other relay (1CR) operates. These relays control the reversing motor starter which, in turn, controls the power to the correction motor. The correction motor drives the mechanism to correct the error in lateral register which has been detected.

This two-point side register control is *not* a continuous correction device. It requires a definite lateral variation of the web from the on-center position before any correction is made. Since the web must always be under the scanner, it is a continuous sampling device. The control is set so the referenced edge or line moves through the center of a light beam or spot. With the material in its centered position, a fixed amount of light reaches phototube V1. With the BALANCE control adjusted to match the phototube signal, both relays (1CR, 2CR) are open.

In the balanced condition, both sides of V2 conduct, and both of V4's grids are so biased that the plate currents in both halves of the tube are equal, at some small current which does not energize either relay.

If the phototube receives more light because of a lateral deviation of the material, it passes more current. The current flows through resistor 1R or other sensitivity resistor, making one of V2's grids more postive. This increases V2's plate current. Current also flows through resistor 9R which raises the cathode voltage on the other half of V2. This lowers the grid voltage, and turns off the other half of the tube. The current in one half of V2 increases, while decreasing in the other half by approximately the same amount. Thus, with an increase in light to the phototube, the voltage at V4-a's grid decreases, due to an increased drop, while the voltage at V4-b's grid increases by an equal amount.

When V4-b's grid goes sufficiently positive, that section of V4 conducts enough current to energize relay 2CR. Meanwhile, V4-a's grid has gone negative and that section of V4 does not conduct and relay 1CR remains dropped out.

When the contacts of relay 2CR close, the correction-control devices move the material in a direction to correct the deviation.

As the correct position is approached,

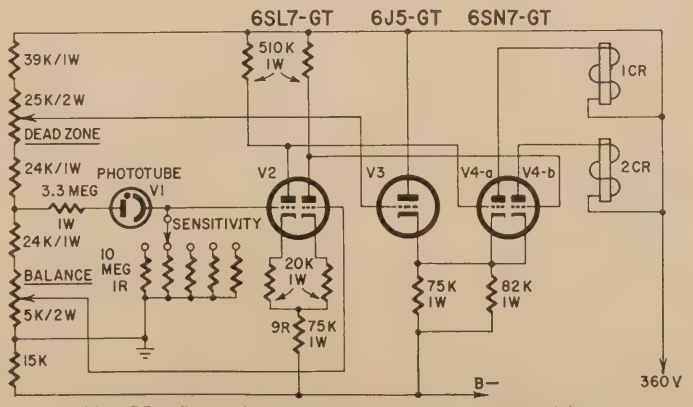


Fig. 11—Partial schematic of G-E type CR7515-S118 side register control.

the light reaching the phototube decreases, V2's grids are again at the same potential and the potentials on V4's grids are matched. V4-b's plate current decreases to its balance value, and relay 2CR drops out.

A decrease in light reaching the phototube, because of a deviation in the opposite direction, runs the control system in reverse. Relay 1CR is energized, the correction is made, the material returns to the in-register position once again, and relay 1CR drops out.

V3 is a cathode follower that keeps V3's and V4's cathodes at several volts positive with respect to V3's grid. With the control in the balanced condition, the voltage on V3's and V4's cathodes determines the bias voltage on V4. Thus the voltage on the cathodes determines the width of the zone (called "dead zone") in which neither relay is energized. By increasing the voltage on V3's grid (increasing the dead zone setting), V3 conducts more, the bias on V4 is increased, and the dead-zone size increases. An increase in the dead-zone size decreases the control's accuracy and the systems tendency to hunt. This adjustment should be set to give the highest accuracy possible without hunting.

So far we have examined side-register photoelectric controls designed to keep the web straight during a continuing industrial process. Next month, we will take a close look at cut off controls that insure cutting a roll of material into exact-size sheets. We will also see what servicing techniques work best for these devices. TO BE CONTINUED

WHALING BY ELECTROCUTION

The Russian whaling ship *Slava* has been equipped with a unique system to kill whales almost instantaneously. The cable linking the ship to the harpoon is not the ordinary type, but is an electrical conductor. When a whale is harpooned, a powerful electric discharge is sent through the cable to kill the whale painlessly.

The reason given for the adoption of this very humanitarian device is that it does away with the long struggle between harpooning and killing the whale, a struggle that could last hours.

TV Tech *to* MILITARY TECHNICIAN

By EDWIN N. KAUFMAN

At one time or another every TV technician has thought about getting out of the TV service field. One alternate to TV service is work in related aircraft, missile, computer or other types of military electronics.

In investigating job opportunities, commercial electronics should be rated secondary, as overworked and underpaid in comparison to most military electronic jobs. Maximum technician's pay for military electronics (in California) ranges from $3.25 to $3.80 per hour. All overtime is time and a half. It is my understanding that there are many similar openings in Florida as well as other Eastern states at the same pay scale.

Newcomers to the military electronics field are usually offered somewhere between $2.35 and $2.80 per hour. Within 2 to 5 years, depending upon ability, the maximum (present) salary can be reached. The technician with exceptional ability can be promoted to junior engineer, with a future salary limited only by ability.

The advantages of being in business for yourself are well known. The advantage of being a technician in military electronics is (usually) a 40-hour week with a very pleasant Saturday and Sunday off for personal pleasure.

Working conditions vary with the company (all punch timecards), but free life insurance and medical coverage (family additional) is usual. There may or may not be a union. A research or developmental electronics technician usually has the best working conditions. Some companies have both types of positions open while others may have only one.

The newcomer is not in a position to quibble over his first job offer. After doing some work in the field, he may wish to change positions to better himself.

Any military job may require the company to file an application with the Government for your security clearance. The company will keep you on nonclassified work until your clearance is granted.

As in TV service, many types of people (engineers) will be encountered. Most engineers are courteous individuals, happy to explain and aid their technicians in adapting to their jobs. But there are some engineers who can make life difficult. The best thing to do with these is to keep your temper, stay civil and, if the situation is unbearable, ask your superior for a transfer rather than quitting.

Types of work range over the entire electronic spectrum, including everything from the general electronics field to specialized work in radar, computers, etc. The actual jobs can range from missiles, aircraft, communications, instrumentation, ground support, to any of a hundred similar groups. All will prove interesting. The title of a company often has little to do with the electronics work being done.

Although some firms will hire any TV technician, many will not because of his complete lack of know-how outside of the TV field. There are three subjects that can help the technician. He should study one or more of them, preferably in an accredited night school. A correspondence school is also good. In order of importance, subjects are transistors, radar and computers. Further study on instrumentation and measurement techniques could also prove useful. If night or correspondence courses cannot be arranged, home study using the books listed at the end of the article should be satisfactory.

To apply for an electronics position, send a letter to the personnel manager of the company that you are interested in, requesting an application. Mention that you will submit a resume with the completed application. The resume should mention your school education, technical education and any other items of interest, such as an FCC license.

The best of luck to you— END

Recommended Books for Home Study

TRANSISTORS

Leonard M. Krugman, *Fundamentals of Transistors*, John F. Rider. $2.70.

Rufus P. Turner, *Transistors, Theory and Practice*, Gernsback Library. $2.95.

Richard F. Shea, *Transistor Audio Amplifiers*, Wiley. $6.

RADAR

Simon Ramo, *Introduction to Microwaves*, McGraw-Hill. $3.

Radar Electronic Fundamentals NAVSHIPS 900,016. (Order from Superintendent of Documents, US Printing Office, Washington 25, D. C.) $1.25.

COMPUTERS

M. H. Aronson, *The Computer Handbook*, $2.

Digital Techniques for Computation and Control. $6. (Order both from Instruments Publishing Co., 845 Ridge Ave., Pittsburgh 12, Pa.)

TV TUNER with a GUIDED GRID

Tiny TV tuner uses new kind of vacuum tube. Features better performance

By E. D. LUCAS, JR.

LIKE space vehicle electronics, TV tuners are being shrunk as drastically as Alice was pygmied on her way to Wonderland. And it becomes wonderful indeed when you look at the conventional-size Standard Coil vhf tuner and contrast it with the new Guided-Grid model. Examining them side by side (see photos), you see that the miniature turret fills only about a quarter the volume of the earlier tuner. Yet the tiny newcomer features superior performance, and can be used for uhf reception with appropriate coil strips. Also, service technicians will probably judge it easier to work on because of its functional design—its dust cover is easily removed and the printed circuit board is mounted above the turret.

It is only natural that the Guided Grid miniature turret should prove popular, with the current trend toward portable TV sets and consistently flatter chassis. Front ends are tending toward flatness like the silhouettes of the highest-paid Vogue models.

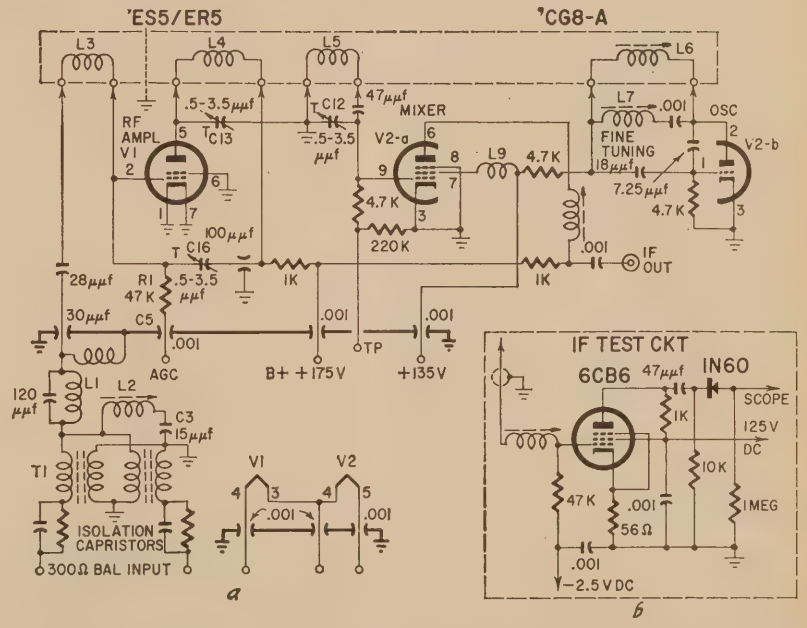


Fig. 1-a—Circuit of the Standard Coil vhf-uhf tuner; b—test circuit replaces if strip.

Circuit description

Examining the schematic in Fig. 1-a, we see a vhf antenna input assembly made up of two isolation capristors (printed-circuit resistor–capacitor parallel networks), a balun (T1) to transform the input impedance from a 300-ohm balanced impedance to approximately 75 ohms, and two traps. The variable inductance in one of these traps (L2) can be adjusted in the field, while the other trap (L1), is factory-aligned. Both are tuned to the intermediate frequency to afford additional if rejection.

An outstanding electronic feature of the tuner is the rf amplifier tube, the 'ER5 or 'ES5, in an improved version of the neutralized triode or Neutrode circuit. This tube was developed as a result of the cooperative effort of Robert C. A. Eland, director of research of Standard Coil Products, and two major tube manufacturers. Included in the tube are additional elements added to pin 6, as shown in Fig. 2. These elements are what the inventor calls the Guided Grid, and they act as shield plates which draw no current. They reduce the plate-to-grid capacitance, thus raising the plate impedance. They also reduce radiation, as compared with that of the 'BN4 type previously used in the Neutrode circuits. With the higher plate impedance, the circuit does not damp the inductance of coil L4 so much. As a result, the tuner's gain is considerably higher, and its signal-to-noise ratio is improved.

As before, the circuit is neutralized by adjusting trimmer C16. To adjust C16 properly, agc voltage must be supplied through feed-through capacitor C5 and resistor R1, with just enough agc level to cut off the tube. A signal is then impressed on the antenna terminals, and the tuner's output is observed through a suitable detector. C16 is then adjusted for minimum response. Capacitors C13 and C12 permit ready compensation for variations in capacitance that may occur when tubes are changed.

The amplified rf signal goes from L4 to L5, two mutually coupled coils, with L5 the grid coil of the mixer (the pentode section of the 'CG8-A). If you

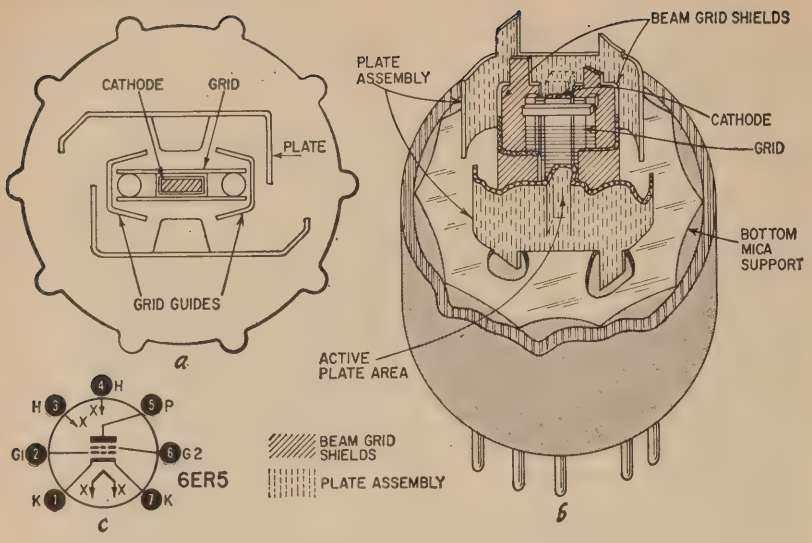


Fig. 2—Cutaway diagram shows construction of the Guided-Grid tube.

want to look at the bandpass characteristics of the tuner up to and including L5, connect a scope to the test point marked TP.

In the mixer, L9 has been added in the screen grid circuit to provide some controlled regeneration and to prevent what would otherwise be a loss of gain over the vhf channels. The local oscillator circuit (the triode section of the '6CG8-A) is conventional. L6 is the tunable oscillator coil and L7 represents the variable inductance of the fine tuning. The manual fine-tuning control moves a slug in and out of a coil wound on a ceramic core.

As shown in Fig 1, the tuner's if output is what may be called low-side capacitance coupled to the input of the first if amplifier stage (which is not part of the tuner, of course).

Gain measurement

To measure the tuner's gain, a reference signal is applied directly to the grid of the if tube in the test circuit (Fig. 1-b) or the first if tube in an if strip. This reference is at a frequency within the if passband, and its voltage is usually about 0.1 volt. A detector, either at the end or in the middle of this if strip, or at the test circuit's output drives an indicating meter. The indication on the meter connected to the detector is then noted, as well as the specific level of the signal fed to the grid of the first if stage.

A signal on the channel frequency is then applied to the antenna terminals and its level is adjusted for the same reading on the meter connected to the if detector. The ratio between the two signals, namely the reference signal and that impressed on the tuner's antenna input, gives you the tuner's gain. The if test circuit shown in Fig. 1-b can be used in lieu of a complete if amplifier and its detector or an auxiliary detector. The test circuit is preferred as it avoids the chance of error that might be introduced by a misaligned if strip.

There are two points at which the bandpass characteristics of the new tuner may be observed. One is at the test point (TP)—it shows the bandpass of the rf amplifier and grid coil of the mixer. The other is at the output of the if test circuit—it indicates both rf response and the unit's if bandpass. Signals are applied from a sweep generator centered on the selected channel frequency. You can observe bandpass on an oscilloscope synchronized to the generator's sweep rate.

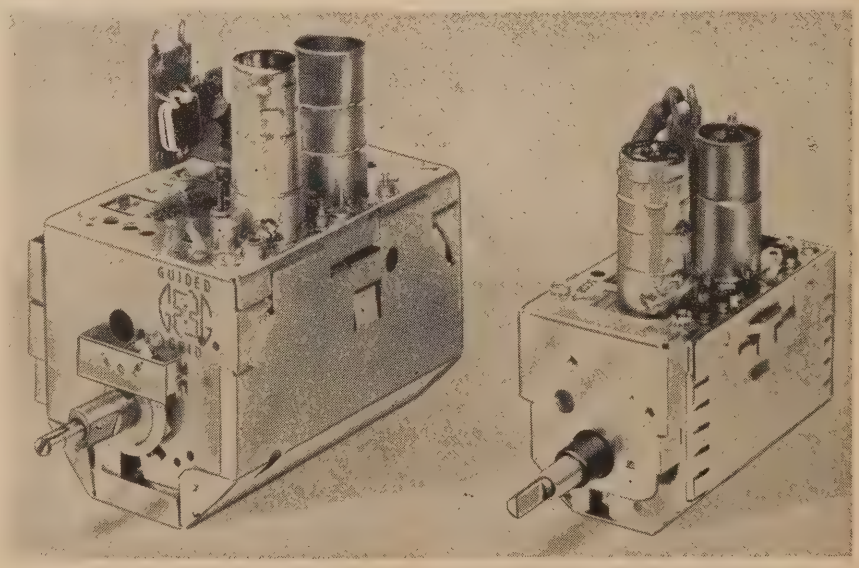
Noise factor is normally measured only at the factory. For this test, a noise diode is usually used to generate a uniform noise voltage over all desired TV frequencies. The tuner is operated with a stable if amplifier, and its output is connected to a meter that can read the residual noise content of the signal produced at the second detector. This if amplifier is so adjusted that its gain may be reduced by 3 db without deteriorating its bandpass characteristics. This can be done with a pad or a bias control. A signal from the noise generator introduced at the antenna input, is now fed through the tuner. With the if stage gain reduced by 3 db, the noise level from the noise diode is increased until the original residual noise reference is reached. The reading on the meter at the detector shows the noise factor.

It might be mentioned that the new miniature turret tuner operates well within the limits established by the FCC for vhf oscillator radiation. When uhf coil strips are used, the tuner is still well within the limits for uhf oscillator radiation.

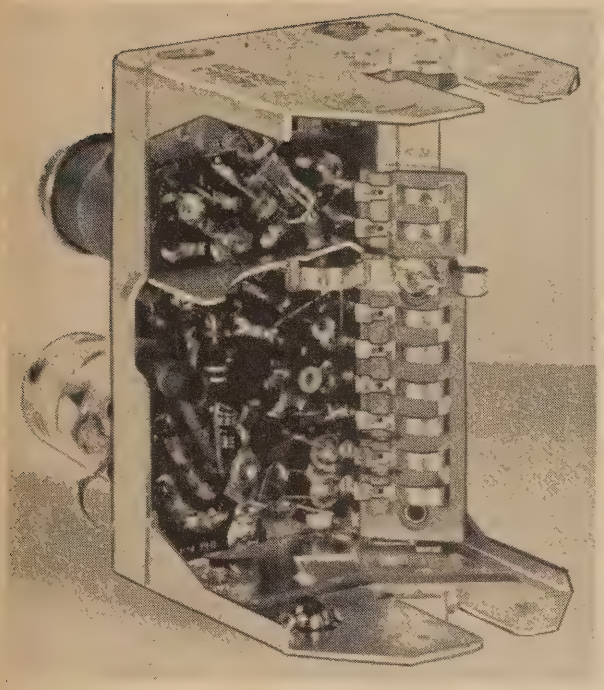
Mechanical features

The Guided Grid tuner appeals to service technicians because of several mechanical improvements. The dust cover is easily removed—merely press the springy slotted sections on each side of the cover. There is a ball detent for positive contact of coil strips on the turrets with the stator contacts. The strength of the coil boards is the same as in the big turret. Contacts are preloaded. Standard Coil uses an automated life-test machine, and the company's engineers state that the new tuner's operation is satisfactory for at least 50,000 cycles of turret rotation. A cycle is one complete rotation of the turret in one direction, and then an equal rotation in the opposite direction.

Component replacement works the same as with the larger earlier tuners; clip out defective units and solder in conventional parts. Practically all parts associated with the rf amplifier, mixer and oscillator, except for the antenna input assembly and the coils on the coil board, are either mounted on, or part



Miniature TV-tuner with Guided-Grid Neutrode circuit is on the right. It outperforms previous standard-sized version.



Bottom view of the Guided - Grid tuner with cover and turret removed to show the tuner's printed circuit board.

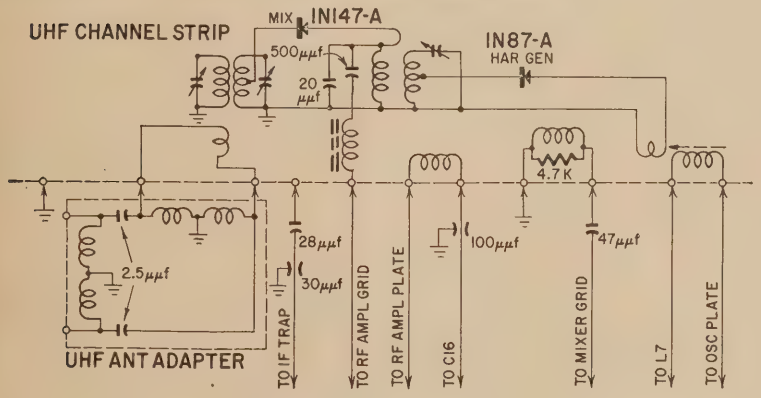


Fig. 3—A simplified circuit of a uhf tuner coil strip.

of, the printed-circuit board, which is installed between the turret and the tube sockets.

Uhf operation

The new tuner accommodates as many as four uhf strips in place of vhf coils. Each uhf strip may have two vhf strips on either side of it on the turret. The uhf strip is placed in the tuner in the same way as vhf boards, except that when a uhf strip is inserted the two vhf boards (one on either side) must first be removed and then reinserted after the uhf board is in place.

When you insert a uhf board in one of these tuners for the first time, you must make sure that the tuner is equipped with a uhf antenna adapter. This assembly is inserted through a hole at the rear of the tuner, adjacent to the vhf antenna input assembly. When the adapter is installed, it connects to the last two contacts on the uhf board as well as an additional contact for grounding which projects over the end of the board and is part of the metal base of the uhf strip.

As shown in Fig. 3, a simplified schematic of a uhf channel strip, this unit utilizes double preselection. The rf uhf signal is converted to the if frequency in the mixer crystal, a 1N147-A, which is also excited by the proper local oscillator voltage from the harmonic selector tank. This selector is excited by a harmonic generating crystal, a 1N87-A, which picks up its fundamental voltage from the vhf oscillator. This oscillator voltage is carried to the harmonic crystal by a link coupling to the oscillator coil.

The mixer crystal's output, as noted, is an if signal which appears across the first capacitor of a pi network. The output capacitor of this network is the input capacitance of the 6ES5 amplifier in the tuner, which now acts as a high-gain if amplifier.

Noise figures in the order of 11 db have been obtained with this uhf strip design, although Standard Coil does not claim this as average performance in production runs. The uhf strips are tuned to a specific frequency. The manufacturer recommends, however, that when one is inserted in a tuner for the first time the technician should touch up the oscillator adjustment, which is reached through the normal adjustment hole.

To sum it up

Performance of the Standard Coil miniature Guided Grid turret tuner is superior to that of larger conventional units. One important reason is the Guided-Grid tube used in the Neutrode rf amplifier stage, in which two shields are placed between the triode's grid and plate. These shield plates reduce the plate-to-grid capacitance, raising the plate impedance and the gain of the tube, while radiation is reduced and signal-to-noise ratio is improved.

Mechanical features of the new tiny unit also include several improvements, including a cover that slips on or off easily, without tools.

The vhf oscillator is very stable, and local oscillator radiation is within FCC limits.

The new miniature vhf tuner can be used to provide reception of as many as four uhf channels by adding an antenna assembly and four appropriate uhf strips in place of vhf strips.

The author acknowledges the very material assistance of Ralph Stubbe, assistant director of research, Standard Coil Products Co., Inc., in the preparation of this article. END

SOUND TAKEOFF

A Magnavox CT-214B needed a new tuner. This set is a split-sound unit with a 21.25-mc sound if. The sound takeoff is right at the tuner. I chose a Standard Coil TV-2232 cascode. Unfortunately, my distributor had the tuner but not the sound-takeoff coil.

Determined to have sound, I examined the schematic for this set and noticed a cathode trap tuned to 21.25 mc in the fourth video if. I figured all I had to do was throw a few turns around it, run a lead to the first sound if grid and sit back and listen. Completing the job, I turned on the set but could get only the faintest trace of audio.

After countless weird sound-takeoff circuits failed, my wife (and technical adviser) suggested, "Why don't you check the tubes?" I grunted, "It's not the tubes." And when her back was turned, I started to replace them. The if and limiter tubes checked good but when I reached for the discriminator, it fell out of its socket. Somehow it had worked loose and was not making good contact.

Plugging the tube in brought the sound thundering through. My original circuit worked and my wife was proud of me and, secretly, of herself.—*Robert D. Schloemer*

1960 TV DESIGN TRENDS

Part II—Circuits, remote controls, and new tubes in the 1960 receivers

By WAYNE LEMONS

LAST month we took a general look at the new lines of television receivers with particular concentration on picture tubes, single-rod antennas, printed circuits and modules.

This month we will go into somewhat more detail, starting with some of the more interesting circuits, remote-control units and this year's crop of new tubes.

Motorola Keyed Agc

An interesting innovation in keyed agc circuits is found in the Motorola TS-556 chassis (Fig. 1). Although at first glance we might think it a more or less normal circuit, the inclusion of a negative horizontal pulse from the flyback to grid 3 of the 3BU8 is unusual. The pulse is used to neutralize or balance the keyer. Without it, a certain amount of the positive pulse appearing on the plate of the keyer will leak to the grid through the tube's capacitance. Though not a serious consideration generally, it could be a factor under marginal conditions. By applying a negative pulse through a very small (2.7-$\mu\mu$f) capacitor, this feedthrough effect is cancelled and circuit operation refined.

Also new is the use of a Hartley oscillator and reactance tube as a horizontal oscillator and control. A triode–pentode type tube (5U8 or 5EA8, see Fig. 2) is used. The grid leak for the oscillator is a 2.7-megohm resistor and, instead of being returned to ground, is connected to the plate of the oscillator tube. According to Motorola, this method enhances the ability of the tube to start oscillating. The dual diode portion of a 6CN7 is used in a conventional phase-detector circuit.

Incidentally, the Motorola printed-circuit board will be easier to make repairs on this year. Long leads on modules, resistors, and capacitors simplify disconnecting and replacing defective units.

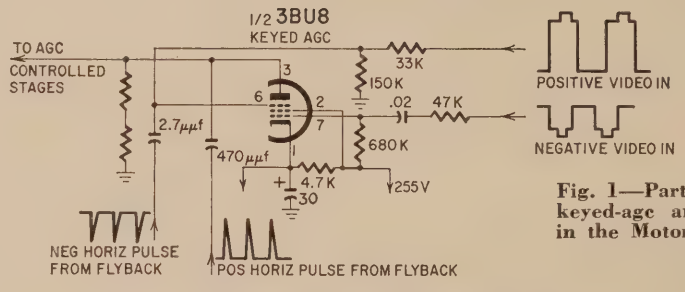


Fig. 1—Partial circuit of the keyed-agc and noise limiter in the Motorola TS-556.

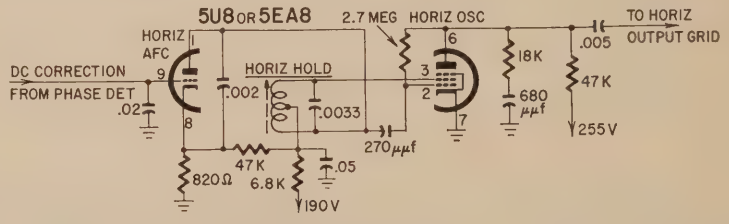


Fig. 2—Reactance tube and horizontal oscillator in the Motorola TS-556 chassis.

G-E Horizontal Retrace Blanking

When definition is as good as it is in many new sets, horizontal retrace blanking is advantageous. This blanking is especially useful in eliminating the snaky white line that occurs when no picture is being transmitted. This effect seems to be especially annoying to some customers. The snaky line can appear in the picture if contrast and brightness are at a critical level or if the fine tuning control is slightly misadjusted.

G-E feeds a positive spike, in their U4 chassis, from the horizontal flyback to the cathode of the picture tube, as shown in Fig. 3. It cuts the tube off during horizontal retrace. Of course, this is not the first time that horizontal retrace blanking has been used. It is essential in the design of color sets. Most companies have at one time or another had some form of it. We include the G-E circuit because it seems

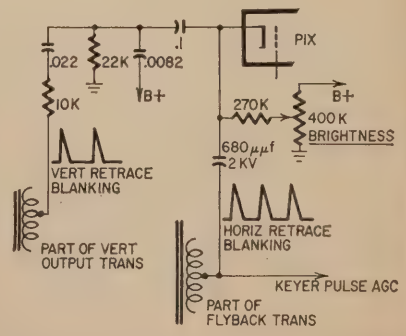
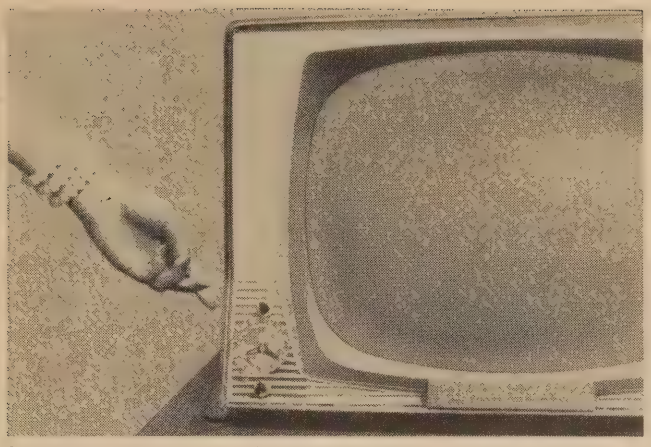
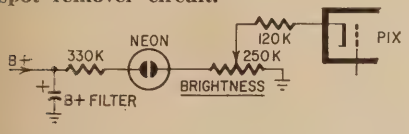


Fig. 3—Horizontal and vertical retrace blanking used in the G-E U4 chassis.



Sylvania 17-inch portable has automatic on–off timer for convenience of late-show viewers which turns set on or off at preset time.

Fig. 4—Zenith automatic spot remover circuit.



one of the simplest approaches.

Zenith Automatic Spot Remover

Fig. 4 shows how a neon bulb is used in some Zenith models to help eliminate the spot on the picture tube when the set is turned off. The neon acts as a switch to keep the charge remaining on the B-plus filter capacitor from being applied to the picture-tube cathode. This makes the tube conduct more and discharge the high-voltage capacitors more quickly when the set is turned off. It has somewhat the same effect as advancing the brightness control.

Clarity and Synchrophase Circuits

RCA is using a couple of new circuits in this year's line. One is a clarity (picture-quality) control found on their deluxe sets. A five-position switch, it connects capacitors in the cathode or plate circuit of the video amplifier to peak or depeak the video response. In this way, the amount of detail on the TV screen can be adjusted.

The other new circuit is the synchrophase system of controlling the horizontal oscillator. This system uses an oscillator and control-tube circuit that is practically the same as that used in the synchroguide. However, it incorporates a balanced-discriminator type of circuit in which a dc correction voltage is formed across the diode load resistors. As in the synchroguide, the phase of incoming horizontal pulses is compared with the phase of the horizontal oscillator. Any difference sets up a dc control voltage that corrects the frequency and phase of horizontal oscillator until they match those of the incoming sync pulses.

Checking selenium phase detectors

Philco recommends that the forward resistance measured on the 10,000-ohm scale of a 20,000-ohms-per-volt meter should not exceed 6,000 ohms.

The back resistance of the diodes should be a minimum of 2 megohms. The forward resistance ratio of the two diodes should be less than 2 to 1. For instance, if one diode reads 4,000 ohms forward resistance and the other reads 1,000 (ratio 4 to 1), the unit should be replaced even though both diodes have less than the maximum allowable of 6,000 ohms. On Philco's the center conductor of the phase comparer is the common negative.

New tubes

Dampers: *6DA4, 6DE4, 12AF3.*

The 'DA4 and 'DE4 are similar to the 6AX4 and have the same pin connections. The 'AF3 is a nine-pin noval-base tube with the cathode connection made to a cap on top of the tube similar to the older 6V3.

Vertical output and oscillator: *6DR7, 13DR7, 6AE7.*

These are dual triodes but with dissimilar sections. One section is used as the oscillator, the other as the output.

Vertical output: *6DB5, 6DT5, 6EM5, 7EY6.*

These are all pentodes used by various manufacturers for the vertical output stage, especially in 110° chassis.

Audio output: *6CA5, 8BQ5, 12DE5.* **Triode–pentode:** *6EB8, 8EB8, 5EA8, 6EA8.*

The 'EB8 is similar to the 'AW8 series. The 'EA8 is similar and interchangeable with the 'U8 series (5U8, 6U8).

Horizontal output: *6EX6, 12GC6.*

Both these tubes have pin connections identical to the 6CD6. Used by Motorola.

Ratio detector and first audio: *6FM8.*

Used by G-E. Similar to 6T8.

Rectifier: *5V3.*

Used by Admiral in some models. Has pin connections identical to 5U4, but **should not be replaced by a 5U4 or 5U4-GB.** Maximum dc output of 5U4-GB is 275 ma at 450 volts. DC output of 5V3 is rated at 350 ma maximum at 450 volts. Instead of the 5V3 in some runs of Admirals, a 5U4 and a 5Y3 are used in parallel.

Remotes

Remote controls will apparently have their biggest year if the manufacturer is any judge. Except for one or two major companies, remote units, almost universally the wireless type, are being offered to the consumer. This includes remotes for portables too!

Zenith and Admiral (Space Command and Son-R) have mechanical nonelectronic remote units, while most other manufacturers, including RCA's 7-function color-set remote, use transistor remotes.

All use frequencies in the range of 40 kc, for two or three reasons. First, 40 kc is not harmonically related to

Three new RCA Wireless Wizard TV remote controls. On the left is 3-function unit for monochrome sets. Next is 5-function unit. At extreme right is new 7-function unit for color TV receivers.

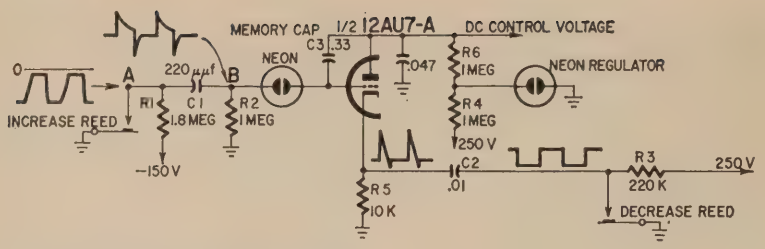


Fig. 5—Partial circuit of Magnavox remote control showing memory section

the horizontal frequency (that could cause spurious triggering), being between the second and third harmonics. Second, it is easy to develop stable signals by either mechanical or electrical means without using expensive materials or crystals. Third, selective circuits are easily designed for use in the remote receiver.

Most transistor units use only a CW signal, or sometimes pulsed CW, to actuate the remote receiver. However, Magnavox uses a tone-modulated CW signal that actuates vibrating reed switches that respond only to particular tones. Using these and a unique "memory" circuit, completely variable control —both up and down—of brightness, sound, and of channel change is the result.

Fig. 5 is a simplified schematic of the memory circuit. When the "increase" button on the remote unit is depressed, the "increase reed" in the remote receiver is excited at the tone-modulated rate and alternately grounds and ungrounds the negative supply through resistor R1. This produces at point A an almost square wave that is differentiated by C1 and R2, putting a positive spike wave form at point B. The positive spikes fire the neon glow tube and the pulses start to charge capacitor C3 in a positive direction. A more positive voltage on the grid causes the tube to conduct more heavily and the voltage drop across R6 to increase. This is the same as saying the dc control or plate voltage is lowered.

You will note that there is no grid return in the triode circuit except through the neon and that the neon is nonconducting unless ignited. This means that whatever charge is placed on C3 has no leakage path, so it will remain for an indefinite period of time. When the "increase" button is pushed then, the brightness (or volume, depending on which circuit) will increase as the button is depressed and will be "memorized" by capacitor C3, thus holding the brightness at that specified value until either the increase or decrease button is depressed again. The time constant of this circuit is several hundred hours, more than ample for normal viewing periods. The "decrease" reed interrupts the negative side of a positive circuit through resistor R3. The square pulse is differentiated by C2 and R5. The negative spike on the cathode makes the triode draw grid current and the charge on C3 is gradually reduced. This, in turn, increases the dc control voltage and lowers the brightness. The 12AU7-A memory tube is operated at reduced heater and plate voltages, which results in very low grid current in the tube itself.

Transistor sets

Only Philco is marketing a transistor set. It is a portable with a 2-inch picture tube with the image magnified about seven times. A special rechargeable 7.5-volt battery powers the set, which may also be operated from the ac line. A full circuit description of this first transistor set to be marketed can be found in the August, 1959, issue of RADIO-ELECTRONICS.

Other companies have shown transistor TV receivers, but none have announced plans for marketing.

Clocks

In catering to the late viewers, several companies are including clock mechanisms for some models in the 1960 line. Most of these units simply turn the set on or off at a given time. RCA, however, has a complete programmer. Setting levers for time and channel, the set owner can schedule an entire day of programs in advance. At the chosen time, the set will automatically turn itself on, select the proper channel and then turn itself off at the end of the program or move to another channel, etc. Possibly the big advantage in these convenience features is that that the set is more complicated and, from a technician's standpoint, probably will mean more service calls.

Summary

There have been no real major changes in either black-and-white or color in the actual electronic circuits. The 23-inch tube and the service accessibility are no doubt the big news for us technicians. There are more speakers in many models. Remotes, clocks and novel cabinet stylings are trends you'll be seeing a lot of in 1960.

Printed boards seem destined to stay with us, mainly, we believe, because they are less expensive to manufacture rather than because of better performance. Printed boards have been improved greatly but whether this will get them completely out of the doghouse with technicians is yet to be seen. It is almost certain that some of the animosity will disappear as technicians grow to trust them more. All in all, it should be an interesting year to watch. How will the public take to the 23-inch tube, color, printed boards, hand-wired sets, remotes, clocks, unusual cabinet designs? Only time and sales figures can tell. END

NEXT MONTH

One-Control Multimeter

One range-setting switch is all that is needed in this new multimeter. Not only is zero-setting eliminated, but the circuit is so designed that maximum current in the low-ohms position is limited to 500 μamp. Measures up to 750 volts dc and ac, has three current ranges to 150 ma and a VU scale.

Balancing Motors by Electronics

If the motor armature does not run absolutely true, a phonograph may be noisy or a small appliance have a short life. Rotors today are balanced by electronics, and the balancer is an important piece of industrial electronic equipment. This article tells how they work and how to operate them.

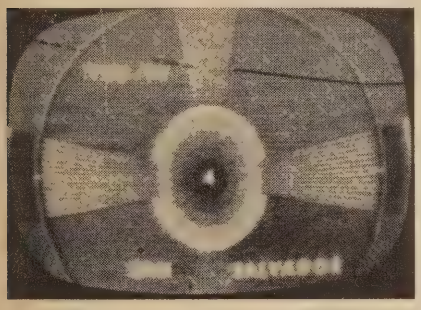
Electronic Voltage Regulator for Your Car

A four-transistor circuit overcomes most of the disadvantages of electromechanical types of regulators. Because of the high amplification of the transistor circuit, regulation is very close. Life and reliability of the unit is limited only by the quality of the components used.

fm tv dx in 1959

By ROBERT B. COOPER, Jr.

IN the past year, 760 dx enthusiasts interested in long-range television and FM reception have contributed material and dx reports to this column. Just by stacking these reports alongside one another, separated into the months of the year, it is easy to see



Test pattern of YSU-TV, channel 4, San Salvador, El Salvador, as seen by dxer Don Ruhland in Holly Hill, Fla. Distance—1,100 miles.

the potential for June and July. The chart shows the two most apparent facts. In a month-by-month comparison for the period November, 1958–October, 1959, the number of reporters (using official TV Dx Column logging sheets only) is compared with the number of dx loggings for each monthly period. And the total number of dx loggings is further broken down to depict the number of E-skip loggings (shaded area) versus the total number of dx loggings for the month. It was a very busy year for dxers, and a year involving a mountain of listing and other paper work for your editor.

The chart shows several facts most experienced dxers know well. At least half of the dx logged during the year was of the sporadic-E variety. This is probably traceable to the fact that many dxers "dx" only during the summertime Es season, and neglect periods of the fall, winter and spring when ground wave, MS (meteor scatter), and other forms of dx run rampant. The number of skip loggings rises to a peak in the summer months of June and July. The range from the high of 1501 Es loggings in June of '59 to the low point of but 4 in March, '59 shows that the frequency and duration of E-skip reception varies greatly in a short period of time.

Unlike TV dxers, the FM set found more interest in chasing long-haul ground wave (also known as trops) signals than the Es type of signals. Many dxers found to their surprise FM signals often pop in from stations 400–600 miles distant, when no signs of dx are apparent on TV dx channels. And such types of openings often affect only one or two FM stations—lasting with good fidelity for 15 to 30 minutes before disappearing. Propagation scientists still have to explain this phenomenon and this year's dx reports will be a great help in their studies.

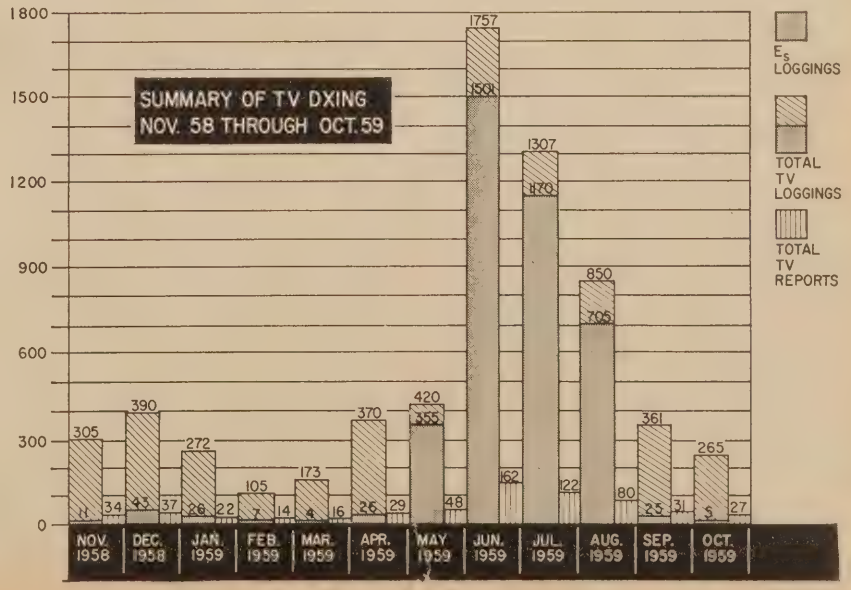
Unusual and rare reception

Studying the reports of the dxers on the peninsula of Florida for this past summer, one fact becomes quite apparent. Reception across the Gulf from stations in Mexico, Puerto Rico and many other Caribbean countries was on the increase this year. Still many stations in this area operating with good-size power and antennas which should have been logged, were not. Their unusual operating hours may not have coincided with the hours of the dx openings to the mainland USA. Or perhaps dxers have regained a habit common in 1952 and '53—writing off every unidentified Spanish-speaking station from the south as another Cuban transmitter.

Whatever the cause of these trends, we do know alert dxers did see new stations in new countries—El Salvador is one. Dxer Donald Ruland, Holly Hill, Fla., is an excellent case in point. Dxer Ruland nabbed YSU-TV, channel 4, operating from San Salvador, El Salvador (see photo).

September unusual also

September is by tradition not much of a month for E skip and this year was only a small exception. Two unusual E-skip openings did occur in September —the first on Sept. 6, the second on the 27th. The Sept. 6 opening was unusual for such a late season period because of the scope it covered and the strength of the opening. Skip began around noon EST over the Midatlantic coastal states and drifted slowly westward during the remainder of the day, hanging on as late as 0200 EST on the 27th. The area affected by skip was mostly north of a line drawn from Norfolk, Va., to San Francisco, Calif. The 27th of September produced a mild flurry of Es over the Southern states, from Southern California east to Florida and all along the Gulf coast. But as weak as it was in the USA, the skip effects appeared to extend far to the south of the USA, well into the Caribbean and perhaps even to the northern coast of South America. Dxers in South America report reception of Mexico City stations around 2000 EST. Dxers in the states of New Mexico, Arizona and Texas logged Mexico City reception during



the same period. There is a good chance skip lined up on both ends—only time and the shuffling of reports will tell.

FM reports up!

This was the first full year for FM dx reporting, and although the number of enthusiasts is still less that 250 reporting-wise, the hobby is catching on rapidly. Many more enthusiasts undoubtedly exist—if they could be reached and gathered together into one reporting group (a function of the new magazine *TV-FM Dxing Horizons* to be explained below).

Nearly 500 FM-band dx reports were turned into this office during the 12-month period—many from dxers only beginning the hunt for FM DX stations. In the totals listing, it would be only fair to point out that less than 10% of the active FM dxers ever bothered to mention their totals—thus the sparse listing.

Many of those who are regular readers of this column have known no other editor of the TV-FM dx section, but my connection with this project dates back only to the summer of 1956. RADIO-ELECTRONICS began this series of dx articles in the summer of 1950, following a series of reports made to the magazine by the rapidly growing TV service industry of the late 40's and early 50's. In the decade that has passed, this annual collection of reports from dxers in every state and 37 countries has found its way to the desks of scientists and engineers for detailed analysis, year after year. TV dx observations by RADIO-ELECTRONICS observers have served many useful purposes, and our column has united dxers into a very loose cooperative group. Now it is my unhappy duty to inform the dxing clan that this column is to be discontinued.

In the decade of reporting and dxing, the following this hobby has acquired has grown into the thousands. Speaking as a fellow dxer, RADIO-ELECTRONICS magazine, through its support and work with this column, is to be congratulated for its work helping this hobby grow. Now, however, a time has come when the hobby must either sink or swim—stand on its own merits or fall by the wayside. It is time for every dxer in every corner of the world to join forces with every other dxer for the benefit of the hobby, by supporting a magazine for the hobby exclusively!! Such a magazine is already a reality, and if you do not receive your copy by Jan. 6, 1960, a copy is waiting for you at 820 Tully Road, Modesto, Calif. Drop a postcard for your free copy.

Either activity this year has been unusual, or we have handled it in greater detail than usual, for I find no room in this installment for the usual ratings of TV–FM dx viewers and listeners. Next month we will describe some of the most interesting feats, and list the Over 50 Dx Club as usual, as well as tell a little more about *TV-FM Dxing Horizons*.

TO BE CONTINUED

TV Service CLINIC

conducted by

JACK DARR

COMMUNITY antenna systems are used in many sections of the country. While this is commonly thought of as a feature of life in rural districts far from the TV transmitters, it is also common in metropolitan areas, where many dwellers in large hotels, apartment houses, etc., are served by community systems, because of the impossibility of erecting individual antennas for each tenant.

These systems can create some unusual service problems, probably more virulent in the rural areas, but annoying in all. The reason for the difficulty in the fringe areas is that the technicians are accustomed to working on sets using very small signals. Their thinking is more or less oriented toward obtaining *more* and *more* gain in the TV sets. That trouble can be caused by *too much signal* sometimes escapes them!

The average TV set can deliver good pictures over a very wide range of input signals—from about 50 μv up to several hundred. Signal levels in most cable systems seem to be in the order of 400 to 600 μv for each channel. This should be sufficient to give clear pictures on even the older TV sets.

If correctly installed, the system offers signals on several channels and, by proper use of controls, keep each signal within the same range of amplitude. The better systems are set up as shown in Fig. 1. The incoming signal is picked up by suitable antennas and passed through separate single-channel amplifiers. These have gains ranging up to 25 or 30 db, and each uses a very close-set agc circuit to hold the amplifier's gain to a tight tolerance. Gains of the amplifiers are adjusted to give approximately the same output on each channel.

For small-town systems, where the signals must be transmitted over several miles of cable, the high-band stations are amplified more than the low-band ones. This is necessary because of the greater attenuation of coaxial cable at the higher frequencies. Equalizing amplifiers, with response curves peaked to favor the high bands, are used at intervals along the cable system. For very long runs, the signals are sometimes run through a complete set of single-channel amplifiers just before they enter the distribution system. Filters separate the different signals, and they are fed to individual amplifiers, boosted, controlled, their amplitudes adjusted, and then sent into the broad-band amplifiers of the distribution network.

For apartment-house systems, this is not necessary because of the comparatively short runs of cable, although it is possible to use additional amplification if local conditions require it. The final aim of each system should be to deliver signals on each available channel, at approximately the same level, to each set on the network.

Tuners on the average TV set, while adequate, are not noted for their selectivity! This is a "Law of Nature"—if we expect the tuner to respond to a band of frequencies 6 mc wide, we can't expect the poor thing to drop off sharply on either side of this band. So if we have two very strong adjacent channels, we can run into some interference. To avoid this as much as possible, the signals are separated in the community antenna network. By using frequency changers, possible adjacent channels are converted to another channel, so that there is always at least one empty channel between each pair. This allows us to use a much higher signal level in the system without interference.

Unfortunately, many technicians are prone to blame the cable for unfamiliar troubles—sync clipping, hum, distortion, color-burst attenuation, etc. While it is possible for some trouble to originate in the system, it is usually of a nature which makes itself immediately obvious.

Hum bars can be caused by leakage in tubes or by power supply defects, in the cable amplifiers. This should be immediately obvious since the trouble is on all channels. In metropolitan areas, substituting a pair of rabbit ears for the cable connection should show this up quickly. Checking another nearby receiver for duplicate symptoms is just as quick.

Sync clipping on the cable itself is another favorite. Actual experience has

shown that this *rarely happens!* The signal in the cable is rf. For sufficient compression, the signal would have to be almost detected by the defective amplifier! Because of the high level of signal on the cable, even very slightly gassy if and rf amplifiers, or slightly weak tubes in the agc circuits can cause sync clipping. This is often unintentionally caused by the user himself! Especially if the set happens to have a local–distance switch. If this switch is accidentally set to distance, the high signal level will cause a perfectly normal overloading of the if's.

Attenuation of the color burst is always possible, but is seldom encountered. This is the reason: the amplifiers used in community antenna systems have a tremendous bandwidth, ranging from about 50 up to 220 mc, to cover all the vhf channels. The response curves of these amplifiers are fairly flat with only minor peaks here and there. For the amplifiers to clip the color burst, this curve would have to drop off *very steeply* at only certain frequencies! It is possible, but quite unlikely! If any defect in the amplifier causes this trouble, it would always be accompanied by other unmistakable symptoms of improper operation—hum bars, snow, etc.

Actual cable troubles can be readily identified with a standard field-strength meter and the TV set itself. The field-strength meter will tell you whether there is enough signal to make a picture and the TV screen will give all the information necessary as to its quality. One possibility of trouble in cable systems is adjacent-channel interference, despite the one-channel guard band. If the signal level in the system is too high, windshield-wiper interference and venetian blinds will appear on most or all sets. This can be reduced only by cutting the gain of the amplifiers until the interference is eliminated.

In the outdoor systems in smaller towns, troubles are often found after a heavy rain, especially on long runs of cable. If the polyethylene foam-filled type of coaxial cable is used and the junction boxes are not properly sealed, moisture will enter the cable itself. This increases the attenuation tremendously, especially on the high channels, and will result in snowy pictures. If the highs seem weaker than the lows, check the tuner tubes first, then call the cable office!

Dc restorer

I am one who believes that all TV sets should have a dc restorer circuit. I have a Capehart model 1C213M in which I would like to add such a restorer. Can you give me a circuit for this, using a crystal diode?—R. W., Tacoma, Wash.

Many designers hesitate to use dc restorers in monochrome sets because they feel that component drift could cause objectionable shift in tube operating points. This is summed up in the statement that viewers usually do not complain about loss in picture quality! The cost factor is also important.

Fig. 2 shows a circuit using a 1N34-A diode for a grid-driven dc restorer that can easily be added to your set. The 100,000-ohm resistor in series with the diode reduces the load on the video signal. This passes the 15,750-cycle sync pulses, working into the input capacitance of the diode. Thus, it gives a low-pass filter action where needed. The higher video frequencies are not affected: the restorer operates only on low video frequencies, such as will be found in creating large grey areas of the picture.

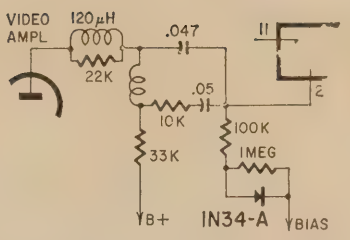


Fig. 2—Simple dc restorer circuit uses a 1N34-A diode. Select diodes with back resistance of at least 750,000 ohms.

Two questions

I have a Philco F4628 which rolls when connected to our cable system. In the shop it works OK. Another set did not roll on the cable. Can you tell me what is causing this? I also have a Capehart CX33 which has a pull in the top 2 inches of the picture.—L. T. V., Montesano, Wash.

Your trouble with the rolling is caused by sync clipping, probably from the high-level signals of the cable. This can be caused by defective tubes in any one of several stages. Most of this, in this chassis, seems to be caused by the video if amplifier tubes. Test them carefully, especially the first and second stages, and you'll find them slightly gassy. Gas currents flowing in the grid circuits buck out the agc bias, letting the stage overload and clip sync. This can also happen in any of the agc-controlled stages, of course. If this does not cure it, check the sync separator tubes for low plate voltage.

The pulling trouble in the Capehart is probably caused by a substandard electrolytic. The output capacitor (last one in the filter circuit) is the most likely suspect here. Run a complete readjustment procedure on the horizontal oscillator—short out the ringing coil, adjust the hold control for best picture, remove the short and adjust the ringing coil for stationary picture. If shunting the old electrolytics with new ones does not cure the trouble, take the old units completely out of the circuit, one at a time, replacing with new ones.

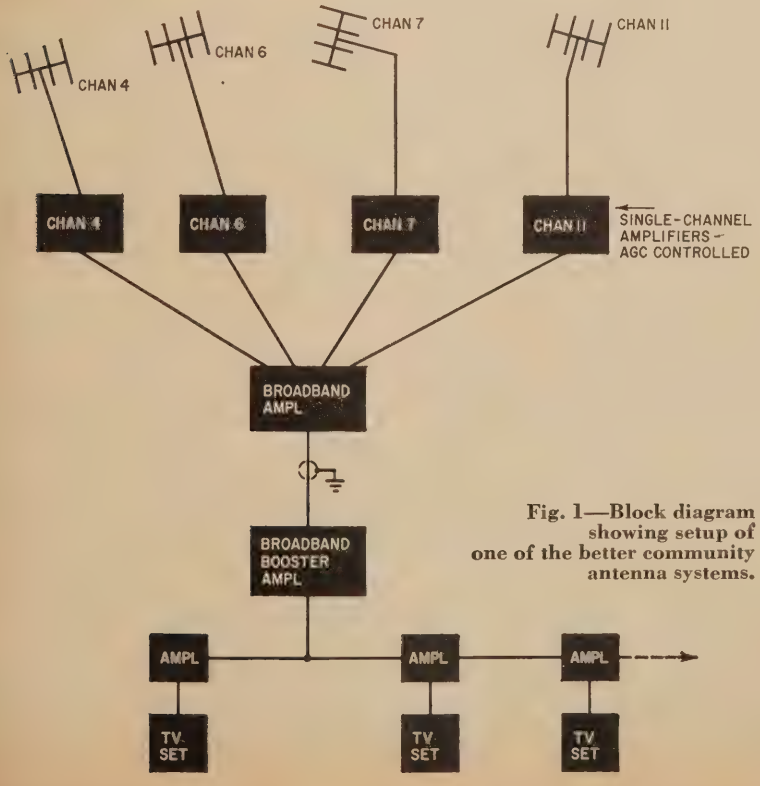


Fig. 1—Block diagram showing setup of one of the better community antenna systems.

Power transformer out

A Silvertone TV set (chassis number 110-449-1) has a burnt-out power transformer and I cannot find any information on a replacement. I would like to modify this set to use selenium rectifiers if possible. I am overseas, and unable to get any information about the set here.—H. H. B., APO 864, New York, N. Y.

A replacement transformer for this

set is a Triad R-35A or R-35BC. This has a 370-volt center-tapped winding for the plate voltage, two rectifier heater windings and two 6.3-volt heater windings. This set uses a 5U4 and a 6X5 as rectifiers and the low-voltage supply is rather complicated. I don't believe the conversion to a dry-rectifier power supply would be practical. Unless the power supply were completely redesigned, using a voltage-tripler circuit, probably the set's performance would no longer be satisfactory.

Insufficient height

A Crosley G17TOMH TV had a bad vertical output transformer and I replaced it with the recommended type, a Thordarson 26S55. Now, the picture is only about 2 inches high, and I can't get any more height. I have tied the ends of the windings to make an autotransformer out of it. As it says, the green and black wires.—H. H. N., Hatfield, Ark.

You're going to hate me when I tell you the answer! This is not an uncommon trouble. The output transformer you mention is *already* an autotransformer! If you were using an output transformer with two separate windings, your procedure would be exactly right. However, by tying two taps of the winding together, you have lowered the Q of the transformer to

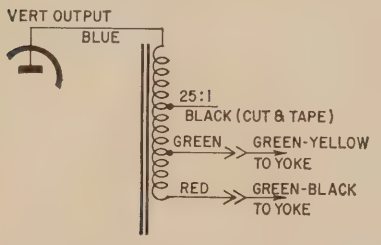


Fig. 3—Correct connection for a Thordarson 26S55 replacement vertical output transformer in a Crosley G17TOMH TV receiver.

the point where you cannot get enough deflection, and your height is bad. This set uses a 50-to-1 ratio in the output transformer. Cut the black wire loose, and tape the end of it. This will give you the correct ratio. The correct connections are shown in Fig. 3.

Retrace eliminator

Could you give me a circuit for adding a retrace eliminator to a TV receiver with a cathode drive to the picture tube?—D. R. W., Towson, Md.

A vertical retrace eliminator can be added to any TV set not using one. Theoretically, it is simple. A sharp vertical spike is fed to either the cathode or grid of the CRT, so it will cut the tube off during vertical retrace.

You can make up an R-C network, as shown in Fig. 4, or get one of the regular PC networks made for the purpose. Sprague makes these in two forms, RS-1 and RS-2. The required vertical-frequency pulse can be picked

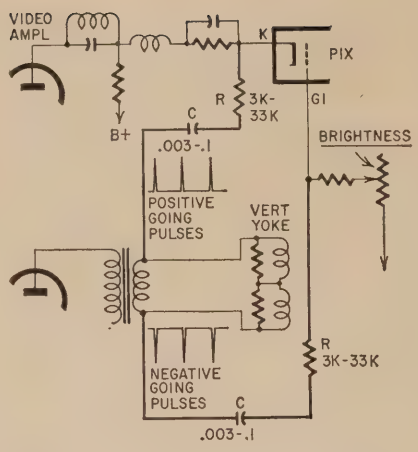


Fig. 4—R-C network adds retrace elimination to a Transvision WRS-3.

up around the vertical output transformer, usually on the secondary or yoke connections. The R-C network serves to couple the pulse to the CRT, and also to differentiate the pulse into a sharp spike.

The pulse need not be fed into the signal element of the CRT: if the signal is fed into the cathode, the blanking pulse can be fed to the grid, and vice versa. Of course this requires a change in polarity. A positive-going pulse on the cathode or a negative-going pulse on the grid will cause the CRT to be cut off.

Dim raster

A Sentinel 1U-1101-T has a very dim raster at about 50% of brightness level. This stays the same throughout the range of the brightness control. The dc voltage from chassis to CRT cathode goes from 0 to 85. There are also retrace lines on the screen.—L. C., Chattanooga, Tenn.

From the symptoms you describe, the most likely possibility is a dead picture tube. The lack of brightness, the retrace lines and the lack of control when the brightness control is varied, all point to this conclusion. Your dc voltage is going well down into the range where the tube should light up if it were OK.

Pix tube breakdown?

I installed a new CRT in a Muntz 17B6. It worked perfectly for about 3 weeks. Suddenly, a snowy picture, chassis hot, a severe corona discharge along the high-voltage lead support. I installed a 500-μμf filter capacitor and killed most of the discharge, but some still appears on the cable support. To get good brightness, the ion trap is located between 3 and 4 o'clock from the rear, tight against the socket. If the picture drops out of sync, the buzzing and arcing surges with it. With brightness turned down, the buzz is severe; at viewing levels it's moderate, and at maximum brightness it almost goes away.—L.A.W., Baltimore, Md.

The steps you have taken so far are right. Now, keep on! The root of your trouble is a corona discharge from the high-voltage lead. The 21EP4 you used does not have an external conductive coating, so you were correct in installing the high-voltage filter capacitor. You might try inserting a well-insulated 1-megohm resistor in series with the high-voltage lead, at or near the high-voltage rectifier socket. Clean off the side of the CRT near the ultor button and spray with Krylon acrylic compound or paint with some good corona dope. (*After* the high-voltage lead is connected, of course!) If the insulation on the lead has deteriorated replace it with a new lead, keeping it as short as possible. It might be advisable to remove the metal lead holder and replace it with a strip of fiber.

The exceedingly high voltages developed around the high-voltage system are the basic cause of the sync trouble.

No high voltage

A Hallicrafters 730 has been brought in with a replacement flyback and a no-high-voltage complaint. I restored the high voltage, but now have a vertical white line down the center of the screen.—C. R. T., Dallas, Tex.

Your report does not state the type of flyback used, but it appears that the core is saturating on peak current flow. This can be corrected by increasing the air gap in the core (which also reduces width). I assume that you have tried backing off on the drive. Another approach is to reduce the 6BQ6's screen voltage to lower the peak current flow. There is a possibility of mismatch between the transformer and yoke, although this is less likely than the other points noted. As a last resort, a heavier flyback will be necessary.

Sync buzz

An AMC chassis has a bad sync buzz. Any suggestions as to the cause?—P. F. M., Brooklyn, N. Y.

Sync buzz can be traced to one of the following causes:

- Ratio-detector charging capacitor (usually a low-voltage electrolytic)—leaky or changed value.
- Ratio-detector transformer — mistuned or defective. Check with a sweep generator and scope.
- Video amplifier overloading—low plate voltage or incorrect grid bias. Screen voltage may be low.
- If amplifier overloading—faulty agc action or misalignment.
- Open bypass capacitors or other defects in if amplifier—regeneration. Check with sweep generator and scope.
- Audio section picking up vertical sweep buzz. If so, tone of buzz changes when vertical hold control is turned through its range.
- Audio section picking up blanking buzz from picture-tube fields. If so, buzz disappears when the picture-tube screen is dark.
- Check filter and large bypass capacitors in the receiver, to make sure that the vertical sweep circuit is not cross-talking into the signal channels or audio channel. END

DESIGN YOUR OWN PREAMP

By NORMAN H. CROWHURST*

Part I—Losser and feedback equalizer circuits

ANY preamp has to have phono-equalization to compensate for the recording characteristic so the response of the program material reproduced is flat. Equalization usually has two parts, bass and treble, and generally is arranged with a number of settings so it can be adjusted to conform to recording characteristics.

As the design procedure is similar for any equalization characteristic, we shall show the procedures for one particular characteristic and the reader can apply the same method to produce a complete set of equalizers for the preamplifier he chooses to build. As the RIAA curve is the one most used these days, we shall design each equalizer to produce this characteristic. The resultant response curve is shown in Fig. 1.

Analyzing the curve

The curve is made up of two parts, shown separately in Fig. 2. The low-frequency part is a step or shelf response that produces an ultimate change in level of 20 db. The critical design frequencies are at 50 and 500 cycles, which means the response at 500 cycles is about 3 db up from the ultimate lower level and at 50 cycles about 3 db down from the ultimate higher level.

The other component of the response is the high-frequency rolloff which gives a loss of 3 db at 2,120 cycles and a 6-db-per-octave rolloff from that point on.

Such a combined characteristic can be built into a preamp in a number of ways. The equalization may be carried out at the same point or it may be distributed between two different points—one for the low frequency and the other for the high frequency. It can be a direct equalization circuit connected between stages or a feedback type.

The latter principle is illustrated in Fig. 3. However, as we shall see in designing the feedback type, it is not always quite as simple as this idealized presentation might make it appear, although the actual circuit might be even simpler than one might think.

Direct method

Taking the simplest approach—putting the equalization between two stages in the amplifier—we will assume that the preceding stage is a 12AX7, using a 100,000-ohm plate coupling resistor. First, we have to introduce a 20-db attenuation to give the 1,000-cycle reference point, because of the 20-db so-called boost we have to provide for the bass.

We *could* do this by shunting the interstage point with a resistance one-ninth the source resistance presented by the tube. Taking the plate resistance of the 12AX7 as 80,000 ohms, the source resistance is 80,000 ohms in parallel with the 100,000-ohm coupling resistor, or about 45,000 ohms. Dividing this by 9 gives 5,000 ohms. This means a 5,000-ohm load resistor could be used in the grid circuit of the following stage.

It also means that the 12AX7 will be

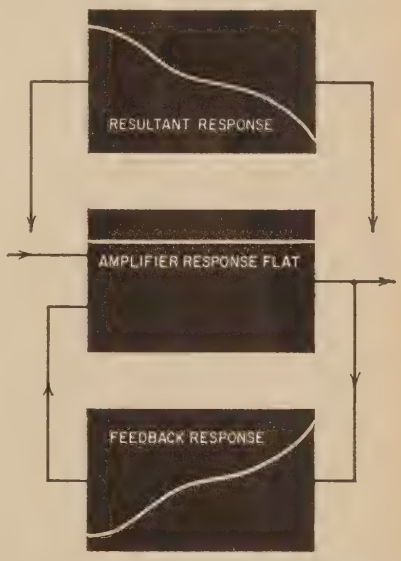


Fig. 3—Basic principle in design of feedback equalizers: Make the feedback response exactly the reverse of the equalization curve.

*Author: *High-Fidelity Circuit Design* (Gernsback Library).

Fig. 1 (left)—The RIAA equalization characteristic.

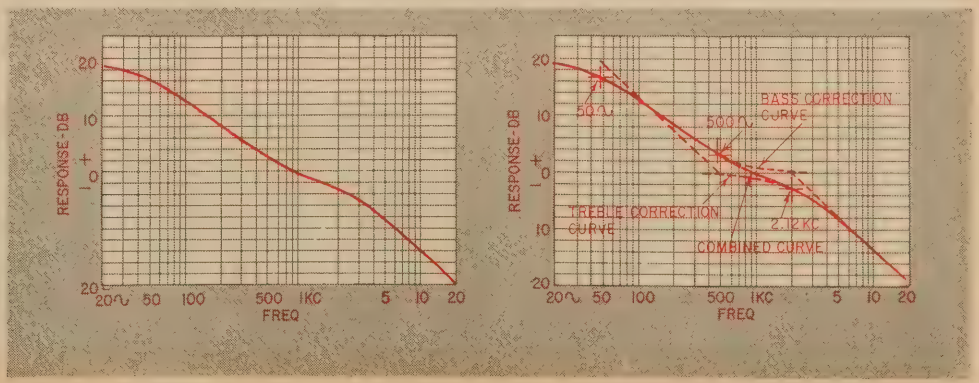


Fig. 2 (right)—The curve of Fig. 1 repeated to show how it consists of two elements, and the design frequencies for those elements.

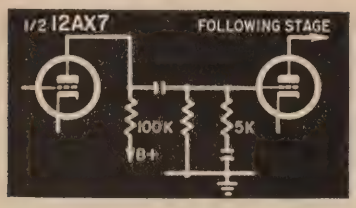


Fig. 4—The start of a design following a 12AX7 input stage. It is not completed because the 5,000-ohm load on the 12AX7 would cause an unacceptable amount of distortion.

operating with a plate load in the region of 5,000 ohms. This represents an almost vertical load line for the 12AX7, which means considerable curvature and distortion in the mid-range frequencies, since the attenuation provides the load in the 1,000-cycle region. This circuit is shown in Fig. 4, but all values are not shown because the circuit is impractical.

To protect the 12AX7 against this kind of distortion, we should provide a series resistance, as shown in Fig. 5. A value of 220,000 ohms is suggested. This will make a total source resistance of 220,000 plus 45,000, or 265,000 ohms. From the viewpoint of the shunting effect of the so-called bass boost, the grid-return resistor, which can be 820,000 ohms, is also in parallel. This brings the resultant to about 200,000 ohms. We can now provide a terminating resistance of one-ninth of 200,000 ohms, or 22,000 ohms which will produce an attenuation of 20 db.

This loads the 12AX7 with the 100,000-ohm coupling resistor in parallel with 220,000 plus 22,000, or 242,000 ohms, a resultant of about 70,000 ohms, which is quite satisfactory for a 12AX7 operating at low level.

To produce a 20-db step or shelf circuit, the capacitor in series with the 22,000-ohm resistor should have a 22,000-ohm reactance at 500 cycles, or 220,000 ohms at 50 cycles. Consulting a reactance chart shows that a .015-μf capacitor will do the job.

All we have to do now is provide a rolloff at 2,120 cycles. This can be done by putting a shunt capacitance on the grid of the second stage. What we need to know is the effective resistance which the capacitance will be shunting at this frequency. Looking back, toward the plate of the 12AX7 there is the 265,000-ohm source, and then, in parallel with this, there is 22,000 and 820,000, a resultant of about 20,000 ohms. So the capacitance should have a reactance of 20,000 ohms at 2,120 cycles. A .0039-μf capacitor comes closest and since it is in the 5% range, the accuracy should be quite good.

However, it may be necessary to use a slightly smaller value because of the input capacitance of the following stage, which will contribute to this. Probably a .0033-μf capacitor will give about the right response.

Thus Fig. 5 represents a circuit that will give the RIAA curve. By providing other values, which can be switched in as alternatives to the ones shown, the circuit can give a variety of other equalization curves that may be desired.

Pentode

If, as in Fig. 6, the preceding stage is a pentode, such as a 6AU6, the intervening resistor to protect the linearity of the 12AX7 is not necessary. As the coupling point is going to be shunted down to a lower resistance in the middle frequencies, a high value coupling resistor can be used. For example, 1 megohm with a correspondingly high screen-feed resistor, about 2.7 megohms, will work here.

Under these conditions, the tube will have a transconductance of between 2 and 2.5 ma a volt and its plate resistance will be in the region of 1 megohm. This means the source resistance can be taken as the two 1-megohm resistances in parallel, or 0.5 megohm. Using a 1-megohm grid-return resistor, which is about the highest value practical, the total circuit resistance at this point drops to 330,000 ohms. Dividing this by 9 means that the shunt resistor in the grid of the following stage, operative at 1,000 cycles, should be about 36,000 ohms. The bass-boost capacitor should have a 36,000-ohm reactance at 500 cycles, or 360,000 ohms at 50 cycles. A value of .009 μf will do.

The effective parallel resistance at this point is now 33,000 ohms, so we can get high rolloff by using a capacitance whose reactance is 33,000 ohms at 2,120 cycles. A value of .0022 μf would seem to work here, except for the circuit's natural capacitance. Probably .0018 μf will give the right response.

In each of these circuits there is no grid return unless an additional resistor is used to bypass the bass-boost capacitor. The part of the calculation that brings this in is often overlooked. This can invalidate the calculation. Choosing a suitable value is not easy. If the grid-return resistance is too high for the following stage, the circuit will need redesigning. Where the circuit seems to need an unusually high value, it may be possible to use grid-current biasing in the design, or at least it can be based on partial grid-current biasing.

For example, if the recommended value for grid-current biasing, with the cathode returned directly to ground, is 10 megohms in the grid circuit, and you use a 2.7-megohm return, it will provide about one-third of the necessary bias. The other two-thirds should be provided by cathode biasing. If the normal cathode resistor should be 1,000 ohms, an actual resistor of 680 ohms will give the remaining two-thirds.

Check working levels

From the data just given we can calculate the approximate gain of the 6AU6 pentode at 1,000 cycles. With an assumed transconductance of 2 ma per volt, which is the best figure we can find, the plate-load resistance is effectively 1 megohm in parallel with 35,000 ohms, or about 34,000 ohms. This will yield a gain of about 68, which is satisfactory if the pentode is being relied upon to give high gain for satisfactory input noise level.

In applying the triode circuit, it should be remembered that there is an attenuation at mid-frequency. This will bring the signal level down that much closer to the noise level. If the input stage's gain is only a little more than the attenuation, the signal level at the grid of the second tube will be not much higher than the signal level at the grid of the first tube. Thus, if noise is a problem in the first stage, it will still be a problem in the second stage.

In this example, the 12AX7 has a 70,000-ohm working load, giving a gain of about 47. Then the 220,000 with the 22,000 and 820,000 ohms in parallel cuts this by a factor of $\frac{241.5}{21.5}$, or 11.2, leaving a net gain of 47/11.2, or 4.2, about 12.5 db, for the first stage at 1,000 cycles. More gain would be better so it is best to use two stages before attempting this kind of equalization.

The only exception to this is the high-end rolloff. If desired, it can be placed in an early circuit as it will help minimize noise by restricting the noise bandwidth. We can even put the high end rolloff ahead of the first stage. In fact, with magnetic pickups, where the pickup's impedance contains considerable inductance, it is often possible to get the high-end rolloff merely by terminating the pickup with a suitable resistance. This is a simple way to get the high-end rolloff, but it may deteriorate the signal-to-noise ratio, if too low a resistance is required to achieve the objective, because it will load down the output from the pickup at the middle frequencies.

This depends on the relative resistance and inductance in the pickup. If the resistance required to give the rolloff at the correct place is appreciably

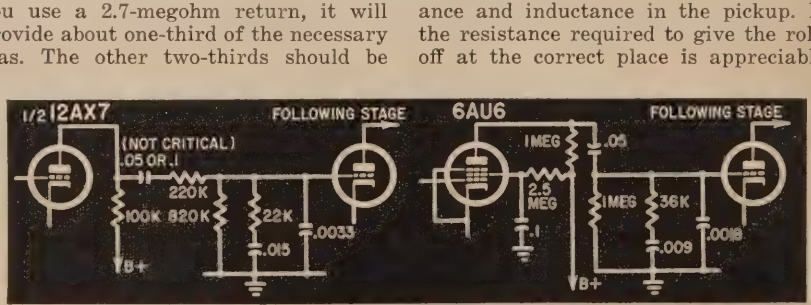


Fig. 5—A satisfactory design for a straight-forward equalizer circuit following a 12AX7 stage.

Fig. 6—A satisfactory design for an equalizer to follow a 6AU6 input stage.

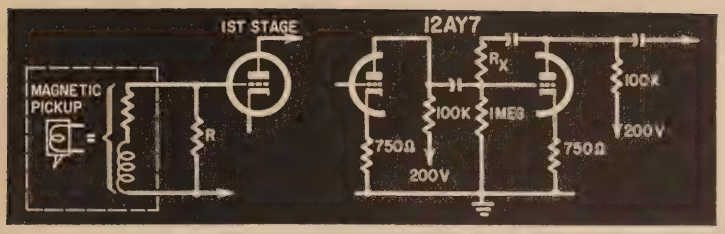
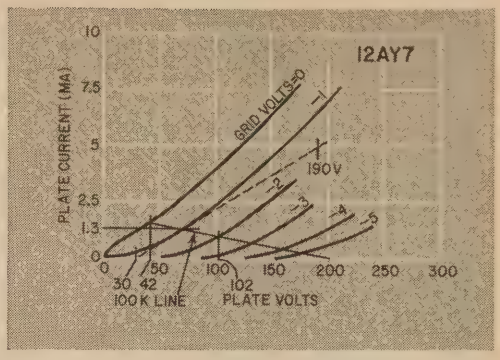


Fig. 7—For some magnetic pickups this arrangement will give the treble or high-end equalization.

Fig. 8—A first try for a simple feedback equalizer using the two halves of a 12AY7.

Fig. 9—The tube characteristics of a 12AY7 showing how the design parameters discussed in the text are obtained.



larger than the pickup's, the method shown in Fig. 7 is quite acceptable.

Feedback circuits

The other type of equalizer uses feedback. The principal reason for going over to feedback type equalization is to minimize distortion. One method uses feedback over only one stage, directly from plate to grid.

It is not advisable to do so over the input stage, because the arrangement is dependent for the exact response on the source resistance from which the circuit operates. To assist in this, the source resistance presented by the preceding stage should be controlled. It may be advisable to insert a series feed resistor to linearize this source resistance to some extent.

Fig. 8 shows a tentative arrangement with a 12AY7 as the input and equalization stages. Fig. 9 shows the characteristics for a 12AY7 tube using a 100,000-ohm load line from a 200-volt plate supply. A bias of −1 volt gives a plate current of 1.3 ma. This means a 750-ohm bias resistor should be used.

Drawing a tangent to the −1-volt curve where it crosses the 100,000-ohm load line, the plate resistance figures out to 32,000 ohms. This can be figured from the fact that the tangent passes through 30 volts 0 ma and 190 volts 5 ma—a change of 160 volts for 5 ma. This represents a resistance of 160/.005, or 32,000 ohms. The coupling resistor in parallel with this produces a resultant resistance of $\frac{32{,}000 \times 100{,}000}{32{,}000 + 100{,}000}$, or 24,000 ohms. To get a good gain figure, use 1 megohm for the following grid resistor.

To find the gain, the 100,000-ohm load line cuts the 0 grid voltage curve at 42 volts and the −2-volt curve at 102 volts—a change of 60 volts for 2 volts in. This represents a gain of exactly 30. Working from a source resistance of 24,000 ohms into a load of 1 megohm, this will divide the gain by a factor of 1.024, leaving a gain of about 29.

To obtain a 20-db boost we need 20 db of feedback over the second stage. This means that a feedback voltage 9 times the normal grid voltage must be fed back from the plate to the grid. As the plate voltage is 29 times the normal grid voltage, this means that the voltage fed back must be 9/29 or 1/3.2 times the plate voltage.

The ac resistance reflected in the grid circuit is 1 megohm in parallel with 24,000 ohms, or about 23,500 ohms. So the resistor to feed back from the second plate will have to be 2.2 times this, or about 50,000 ohms.

Now we see the difficulty in designing this type of circuit. To get a gain of 29, we have assumed a grid resistor load of 1 megohm, but we also need a feedback resistor in the region of 50,000 ohms to get enough feedback, which will load down the tube's gain. We shall no longer get a working gain of 29. To get enough feedback we shall in fact need a lower resistance than 50,000 ohms, which means the gain will be even further reduced.

Assuming we can get 20-db feedback with this circuit, it is obvious that the load line will be of such low resistance as to run into the curvature of the tube considerably, and this will cause distortion. True, the feedback will help minimize the distortion, but the best it can do is bring the final distortion back to approximately its original figure.

An alternative approach is to raise the effective grid circuit resistance. This will also, as mentioned earlier, help minimize any nonlinearity caused by the variation in plate resistance of the first stage. Assume that we use a 1-megohm resistor for the following grid and a 1-megohm resistor for the feedback as shown in Fig. 10. This will reduce the gain of the stage to about 28.

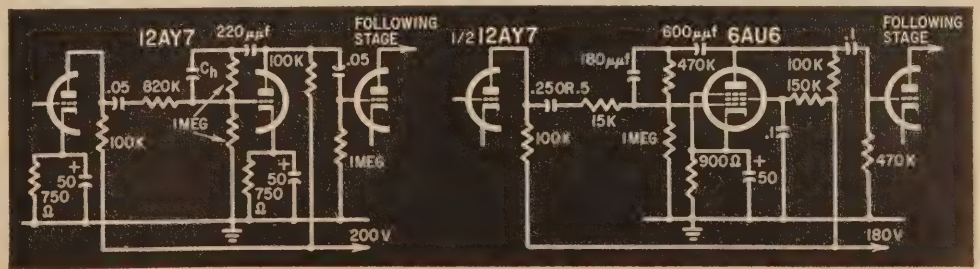
So we still have a factor of 3.1 step-down to meet. This means that the grid-circuit resistance must look like 1/2.1 times the 1-megohm series feed resistor. This figures to 475,000 ohms. We already have a 1-megohm grid resistor, which means that the source resistance must look like about 900,000 ohms. As the preceding stage has an actual source resistance of only 24,000 ohms, a series resistor of about 820,000 ohms (using a standard value) will probably come near enough to achieving the desired overall characteristic.

To give a 3-db boost at 500 cycles, the feedback capacitor should have a reactance of 1.475 megohms. This needs to be 220 $\mu\mu$f. We now encounter two difficulties:

- For the high end, a bypass capacitor across the 1-megohm feedback resistor will give high loss, but can produce only about a 10-db step (by going to 100% feedback) instead of a full 6-db-per-octave rolloff.
- Also, the parallel-fed feedback reduces the effective resistance in the grid of the second tube from the viewpoint of attenuating the signal from the plate of the first tube. It will reduce the effective resistance by a factor in the

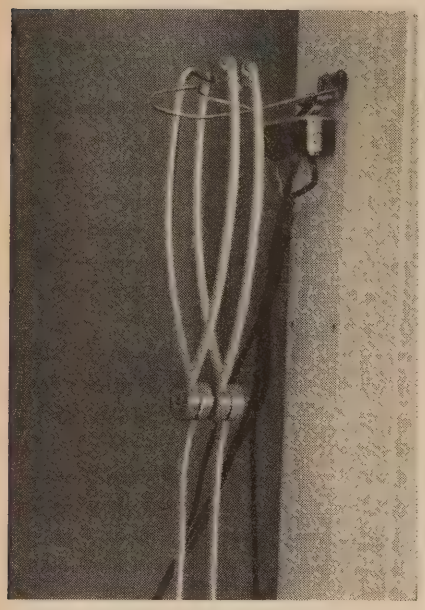
Fig. 10 (left) — Almost satisfactory design using two halves of 12AY7 with feedback over second one.

Fig. 11 (right) — Using 6AU6 for feedback stage makes design of this type relatively easy.



HEADPHONES FOR TV

By WILLIAM B. RASMUSSEN



MOST of us keep the television and hi-fi sets in the same room. We don't want to, but in small apartments there is little choice. Often, we want to use both units at the same time. The only practical way of doing so is to attach headphones to one or the other. The logical choice is to add headphones to the TV receiver since the viewers remain comparatively stationary and the audio range is rather narrow. Since the childrens' TV programs are the ones that conflict most often, the phone system is designed so that they will use it willingly

A child-approved system is shown. It is semi-automatic—the user has only to lift the phones from their hooks to silence the speaker in the set and switch audio output to the phones. Replacing the headphones restores normal operation. The photograph shows the circuits. The phones hang on a hook that rests against a snap-action switch. This spdt unit is wired with its normally open contacts to the speaker and the normally closed side to the phones. Naturally, you would position the bracket as close to the viewing area as practical. In some positions, wiring to the switch can be concealed, in others it cannot.

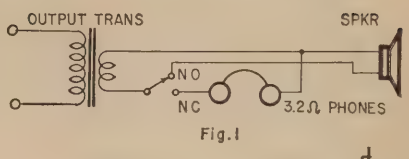


Fig. 1

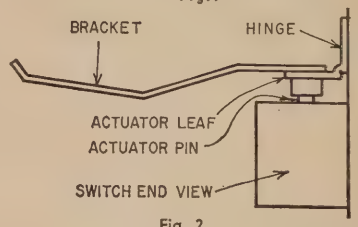


Fig. 2

The wiring for this setup is shown in Fig. 1 and details of the switch arrangements in Fig. 2.

Such systems are so simple that there is no good reason why TV sound should be allowed to disturb nonviewers. END

DESIGN YOUR OWN PREAMP

(Continued)

region of 20 to 1, bringing the actual 1-megohm grid resistor down to an effective 50,000 ohms. Fed through an 820,000-ohm resistor, this represents a loss of about 16 to 1, so that the effective gain from the grid of the first tube to the grid of the second tube is now cut back to about 1.8 at 1,000 cycles, and noise is liable to be a trouble in the equalization circuit as well as the input circuit.

To overcome these two problems for this kind of equalization, it is best to use a tube which has plenty of gain, such as a 6AU6. It can still follow an appropriate triode input stage. Using a 6AU6 with a plate voltage of 180, and taking the figures quoted in the "Resistance-coupled Amplifier Section" of RCA tube manual, a 100,000-ohm plate coupling resistor with a following 220,000-ohm grid resistor, a 150,000-ohm screen-feed resistor and a 900-ohm cathode resistor, gives a voltage gain of 116. Instead of using 220,000 ohms for the following grid resistor, we can use 470,000 ohms for the grid resistor and 470,000 ohms for the feedback, as shown in Fig. 11, which will still give the same gain.

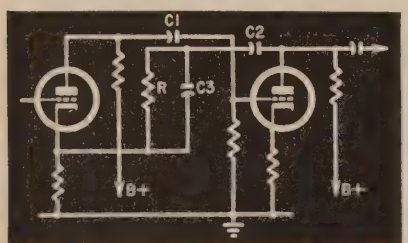


Fig. 12—Showing the method of using feedback over two stages.

So we need a feedback voltage that is the plate voltage divided by 116/9, or 13. Thus the grid-circuit resistance should be approximately 1/12 of 470,000, or about 39,000 ohms. This is much nearer the results we would like. If the preceding stage presents a 24,000-ohm source resistance we can pad it out with a 15,000-ohm resistor and have a 39,000-ohm source resistance.

The correct capacitor for a 3-db reduction in feedback at 500 cycles must have a reactance of 510,000 ohms at 500 cycles. A 600-$\mu\mu$f capacitor works here.

To avoid interfering with the lower end of the response, the reactance of the coupling capacitor from the previous stage should be low compared with 39,000 ohms at 50 cycles. A 0.1-μf capacitor gives 32,000 ohms at 50 cycles, so a 0.25- or, if possible, a 0.5-μf capacitor should be used. If not, the lower end of the equalization characteristic will not be held, because the bottom end of the feedback network will not be maintained at 39,000 ohms.

To take care of the high end, a capacitor is needed to bypass the 470,000-ohm resistor with a reactance of 470,000 ohms at 2,160 cycles. This requires about 150 $\mu\mu$f. However, it may prove to need a little larger value than this, on account of the effective grid input and stray wiring capacitances. Probably a 180-$\mu\mu$f capacitance will be satisfactory in this position to offset these losses.

There are of course many possibilities in the design of feedback type equalization circuits. We could use a high-mu triode such as the 12AX7, employing a similar approach. The points to watch for have been discussed earlier. The advantage of feedback over only one stage is that the possibilities of interaction in the feedback are minimized and the calculations are much simpler.

To get enough gain to make the feedback easily obtainable without too many problems with circuit values, feedback over two stages, as shown in Fig. 12, could be used. The difficulty here is that there is considerably more to the design calculations involved in obtaining the correct frequency response. A future article will cover feedback equalizers in more detail.

To get a simple design which maintains its response with reasonable accuracy when tube parameters fluctuate, stick with the simpler circuit. I feel the straightforward equalizer circuit between stages is by far the best, because change in gain of a tube does not in any way affect equalization. With feedback equalizers the change in the tube's gain is bound to modify the equalization, whichever circuit is employed. By watching that the loads provided for the tube do not go into the region where the tubes cause distortion due to curvature, the straightforward equalizer does not produce appreciable distortion, and the argument of improved quality for the feedback type no longer applies. END

Record changers aren't so tough —if you know what to look for

By P. SHENEMAN

ALL automatic record changers are mechanically different, but some service problems are common to all. A technician who has some mechanical ability, a stroboscope and a lot of patience can solve most of them—often right in the customer's home.

The first common fault is caused by a speed change within a single revolution of the turntable and is called wow. This change in speed produces a wavering tonal effect which is much more pronounced on a 33⅓-rpm disc than on its 78-rpm brother.

A stroboscope placed on the turntable will display a pattern that systematically advances and retreats. (A heavy turntable acts as a flywheel and tends to damp out and smooth such speed changes, especially at the higher record speed.)

When wow is the problem, check for:

- Center hole in records too large.
- Warped records.
- Bent idler wheel.
- Tire on idler wheel out of round.
- Bent pulley shaft.
- Warped turntable.
- Defective turntable bearings.
- Pulley(s) not seated correctly.
- Motor not balanced.
- Bent motor mounting plate.
- Bent motor armature.
- Defective motor bearings.

Change in musical pitch

A changer can play a single record at the correct musical pitch, yet have the pitch become lower as additional records are placed on it. With a full stack of records on the turntable, the last record may be as much as a half a tone flat. This change in pitch may be unnoticed by some, but to others it is very annoying.

To locate this trouble, check turntable speed with a stroboscope when one or several records are on the turntable and when the turntable is fully loaded.

When change in musical pitch is the problem, check for:

- Motor overheating caused by poor ventilation, bad bearings or shorted windings.
- Lack of friction in the turntable driving mechanism.

Slow turntable

Another common problem is the turntable that runs slow. A stroboscope placed on such a turntable will produce a pattern that seems to crawl backward. Like most speed-regulation troubles in record changers, it will be most noticeable on long-playing records.

When slow turntable speed is the problem, check for:

- A pulley binding on its shaft.

  Because of condensation, rust often forms on the pulley shaft. This acts as a parasitic drag and can slow the turntable down by several rpm. To check, remove the pulley by pressing upward at its base with a screwdriver. If the shaft is rusted, sand with very fine emery cloth and lubricate.
- Motor armature bearings that need lubrication.
- Too strong a tension spring on idler wheel.

  The original spring may have been replaced with one with more tension or shortened.
- Worn turntable bearings.
- Low line voltage.
- Defective motor.

Stalls, won't complete change cycle

This is by far the most common trouble. While the record is playing, the phono motor has to oppose only the force of the needle in the record groove and the friction of the tone-arm support. During the change cycle, the motor must provide enough torque to operate all the mechanical parts needed to complete the change cycle. In most rim-drive turntables, the torque is applied by friction. Any loss in friction results in failure of the change cycle.

If the turntable stalls and won't complete the change cycle, check for:

- Grease or oil on turntable rim.
- Grease or oil on idler wheel or pulleys.
- Worn pulley(s), too small in circumference.
- Pulley(s) not seated on pulley shaft.

  Often when pulleys are removed for cleaning or replacement, too much lubricant is placed on the shaft. When the pulley is replaced, air is trapped between the shaft and the pulley hub. The trapped air prevents the pulley from seating firmly. The pulley should be pressed until it snaps into the seating ring.
- Pulleys or idler-wheel rubber impregnated with dirt.

  When dirt is in the pores of the rubber, the pulley has a glossy appearance. To remove the gloss, hold fine sandpaper lightly against the pulley while it is turning. Motors using drive belts to turn the pulleys can have friction restored by turning the belts inside out.
- Weak motor.
- Weak idler wheel spring.

Tracking-error distortion

Correct positioning of the pickup arm and cartridge is essential to minimize tracking-error distortion. Tracking error is the deviation from tangency of the needle in the record grooves as the stylus moves across the record. [For more detailed information on this subject see "Record Tracking," by Norman Crowhurst, (October, 1957, page 40) and "The Record Skips," by Charles W. Farrington, (April, 1959, page 61).]

Since record changers use a relatively short pickup arm, tracking error is much greater in record changers than in single-record turntables. In addition to tracking error, compensation must be designed into the pickup arm to

allow for the change in tangency of the stylus to the record relative to the size of the stack of records. Ideally, the stylus should be perpendicular to the record. This condition is satisfied when a single record is on the turntable. However, as more and more records are placed on the turntable, the stylus assumes an angle to the record. This consideration is a major factor in pickup arm design.

If tracking-error distortion is the problem, check:

- Pickup-arm mounting.

  The arm should mount in its pivots without binding or excessive play.
- Stylus replacement.

  The length and angle of offset of the pickup arm was designed by the manufacturer in conjunction with a certain stylus design. Using a different replacement stylus often increases tracking-error distortion. Also true of a cartridge in which stylus position differs from original.
- Vertical tracking force.

  Vertical tracking force is the pressure the stylus exerts in the record groove. The average is 5 to 9 grams. This tracking force is adjusted by spring tension or a counterbalance. For accurate tracking force, the weight should be adjusted with scales made for this purpose.
- Worn or dirty stylus.

  A worn stylus produces distorted sound and causes excessive wear. Dust and dirt that have collected on the stylus can attenuate the sound pickup and, in severe cases, prevent any pickup at all.
- Loose cartridge.

  A loose cartridge can increase tracking error and cause distortion.

Rumble

Low-frequency noise produced by mechanical vibrations of the phonograph motor is called rumble. Since the pickup arm in an automatic record changer is part of the changing mechanism, these mechanical vibrations can be picked up by the arm and sometimes modulate the recorded signals.

When rumble is the problem, check for:

- Worn motor mounts.
- Motor mounts that have lost their elasticity.
- Poor changer mountings.

  The changer is designed to rest on springs and should not rest on any part of the cabinet.
- Old idler wheel.

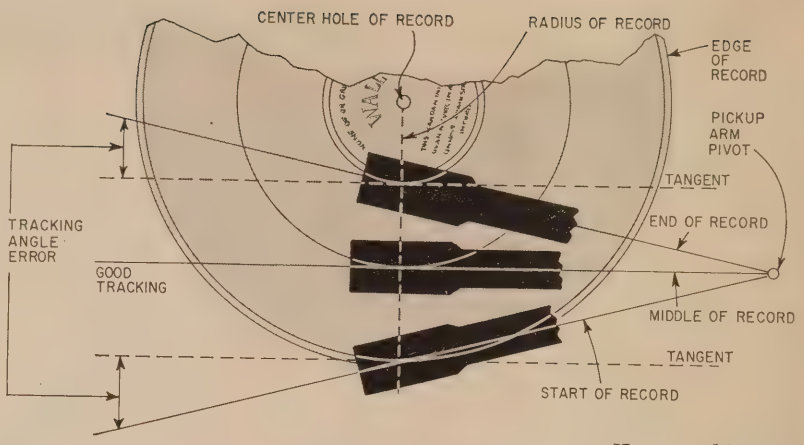
  If the rubber tire on the idler wheel is old and hard, noise will be transferred to the tone arm and cartridge via the turntable.
- Bent armature shaft of motor.
- Motor out of balance.
- Worn turntable bearings.

Stylus replacement

The assortment of styli runs from the steel stylus, good for a few plays, to the diamond, good for 10,000 or more plays. However, life cannot be judged by the number of times a record has been played. The record's condition is a predominant factor in stylus life. Even more than the number of plays, worn or dirty records, incorrect vertical tracking force and binding of the tone-arm mechanism, all shorten stylus life.

When needle replacement is necessary, check:

- Record condition. Discard worn records.
- Correct stylus pressure (vertical tracking force). Too light a pressure causes skidding. Too heavy a pressure speeds both stylus and record wear.



How tracking error is measured

Trip–reject cycle

Tripping, generally referred to as rejecting, is the mechanical action which results in applying power to the record-changing mechanism. In most record changers, this is done by the lateral motion of the tone arm caused by the stylus riding in the concentric groove in the center of the record.

Generally, tripping problems can be separated into three distinct conditions:

1. Won't trip.
2. Trip is activated and change cycle begins but is not completed.
3. Trips continuously.

If the changer won't trip, check:

- Pickup-arm follower.

  The pickup-arm follower follows the pickup-arm movement to activate the trip mechanism. The pickup-arm follower may be caught in a position where it cannot activate the trip mechanism, may be bent so it misses the trip mechanism, or may not be following the tone arm.
- Follower may not have enough friction to activate the trip mechanism.

  The pickup-arm follower as a rule is not connected to the pickup arm directly, but usually follows the movement of the pickup arm because of friction between the follower and pickup-arm mounting arrangement. Friction is generally applied by a coil or arched spring. However, sometimes it might be done by cork or fiber washers between the follower and pickup-arm mounting arrangement.

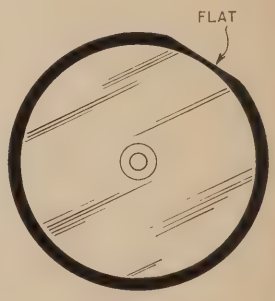
  In many changers, friction can be increased by an adjustment which compresses the spring. With changers using cork or fiber washers, lack of friction can be caused by smooth washers or grease or oil on washer surfaces. Cleaning will often restore the original operation.
- Trip mechanism binding.

  The trip mechanism may be jammed, broken or binding, so the pressure from the pickup-arm follower cannot activate it.

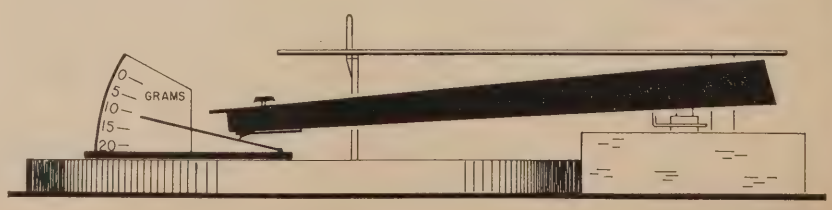
If the changer trips and starts the change cycle but the change cycle is not completed check:

- Binding in the record-changing mechanism.

  The changer may have been



A flat on an idler wheel can cause wow.



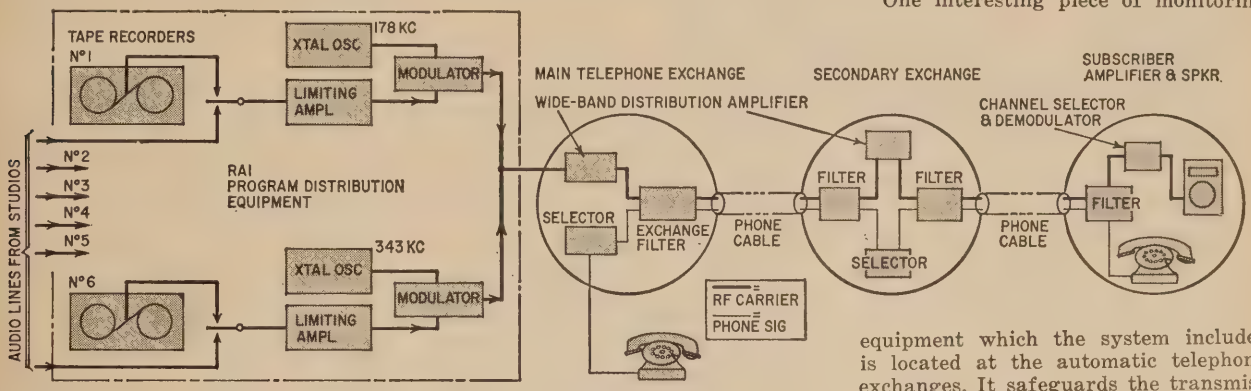
How to measure stylus pressure.

WIRED BROADCASTS IN ITALY

FOUR principal cities in Italy now have a high-quality wired music service available to home subscribers via carrier-current transmission over telephone lines. The Italian Broadcasting System (RAI) has been providing a choice of up to six programs over this wired-broadcast service since December, 1958, in Rome, Naples and Turin. (Milan was added later.)

The carrier frequencies are from 178 to 343 kc, amplitude-modulated with audio up to 15 kc. There are guard bands 3 kc wide between each of six channels. Five channels provide a choice of varied musical fare, similar in many ways to the First, Second, Third, etc., programs of the BBC in England. The sixth channel is reserved for special events such as international festivals and will ultimately be used for multiplexed stereo.

Programs originate in the RAI Studio Centers, usually from special long-playing tape machines. The audio for each channel is fed into a limiting amplifier. Outputs of each of these limiting amplifiers goes to a modulator. The outputs of the six modulators are then fed into a wide-band mixer–amplifier which amplifies all the modulated rf in its passband, 150 to 400 kc. The mixed carriers travel over leased telephone lines to power amplifiers in automatic telephone exchanges, then out to subscribers over the regular phone lines.



The subscriber's equipment may be merely a filter network to separate the normal telephone signals from the carrier programs, if he has a long-wave receiver which can select frequencies between 178 and 343 kc. But as there are no long-wave broadcast stations in Italy, few Italian receivers cover these frequencies and one additional piece of equipment is usually required. It is a small 6-channel selection and demodulation unit.

One interesting piece of monitoring equipment which the system includes is located at the automatic telephone exchanges. It safeguards the transmissions by indicating loss of any carrier and by continuously measuring the amount of crosstalk. It does this by monitoring 455 kc. Since two of the channels (178 and 275 kc) have a sum frequency of 453 and two others (211 and 244 kc) have a sum frequency of 455 kc, any increase in crosstalk between the stations in either of these pairs will produce a proportional output at 455 kc. The crosstalk threshold is kept below 50 db at all times. END

SERVICING RECORD CHANGERS FASTER *(Continued)*

dropped or worked on by its owner so that a part or parts of the mechanism are damaged.

- Loss of friction between the motor and turntable.

If the changer trips continuously, check:

- Pressure applied to the trip mechanism from the pickup-arm follower.

  Very little pressure is needed to trip the change mechanism. Too much pressure may be the result of incorrect adjustment of the friction between the pickup arm and follower. Excessive friction also can be the result of corrosion, rust and the accumulation of dirt.
- Trip mechanism itself.

  It may be jammed in a position permitting constant tripping.

Record drop

There are several systems for making a record changer drop the next disc. Zenith uses an ejector finger that swings out from a flush position in the spindle and rotates 180° to drop the record. In the VM and many other changers, an ejector lever, normally flush with the spindle, moves forward to drop the record. With many Philco changers, the spindle itself moves forward or "nods" to do the same job. Many models by Motorola had an ejector lever, or tongue, in the record support shelf to push the bottom record from the stack of records. As another example, Webcor used the record support shelf itself, nodding or moving forward, to dislodge the record to be played.

No matter which system is used, there are adjustments for controlling the record dropping action.

- Zenith: The ejector finger must be straight and timed correctly.
- VM: Ejector lever in the spindle, the amount of travel of the lever is variable.
- Philco: The movement of the spindle can be controlled for more or less "nodding."
- Ejector lever within the record support shelf: The movement of the ejector lever can be regulated.
- Webcor: Record support shelf moves forward, amount of record shelf movement can be adjusted.

When it comes to record drop, all record changers have one thing in common—a spindle cap, spindle slider, or the angle at the top of the spindle, which prevents more than one record from dropping at a time.

For record-drop problems, check:

- Thickness of records.

  Records that are too thick will not drop correctly. Also applies to records that are too thin.
- Size of center hole.

  Worn or chipped center hole affects record drop.
- Spindle cap or slider.

  If bent, more than one record will drop. Perhaps several.
- Angle at top of spindle.

  In spindles not using a spindle cap or slider, the angle at the top of the spindle prevents more than one record from dropping at once. If the angle has been changed, several records may drop simultaneously.

(RCA makes a series of records for checking record changers. Among the tests they will aid in making are: landing and tripping, pickup sensitivity, turntable rumble and flutter, and record tracking at various recording levels and stylus pressures. These discs are available from the RCA Victor Custom Record Department, 155 East 24th Street, New York 10, N. Y. Write to the attention of the Sales Service Section. Walsco Electronic Products also makes a series of these discs. For information write to Walter L. Schott Co., 100 West Green St., Rockford, Ill.—*Editor*) END

WHAT is an output WATT?

A new approach to an old problem

By CHARLES B. GRAHAM
ASSOCIATE EDITOR

PEAK power, rated output, and now a new one, *music power* . . . what do they mean? How is the confused audiophile, dealer or technician to know what the power rating of an audio amplifier really signifies?

Many years ago we didn't have this trouble. An amplifier produced, say, "30 watts electrical output." Pure and simple. No complications. Then some fussy character asked, "Yes, 30 watts, but at how much distortion?" and the confusion started.

It was agreed that the *maximum power rating* of an amplifier would be that at which it could continuously reproduce a sine-wave input with no more than 5% distortion. (*Distortion* refers to harmonic distortion throughout this article, as EIA—Electronic Industries Association — and IHFM — The Institute of High Fidelity Manufacturers—standards are based on it . . .)

As audio equipment improved, 5% distortion began to look like too much. Manufacturers started specifying tighter standards, often around 2%. Then with high fidelity, the trend shifted to 1% and even lower distortion at rated output. All this for maximum power with a continuous signal input at 1,000 cycles.

Then one large company came out with a new rating, *peak power*. They pointed out that sudden musical transients, usually the beginnings of notes, are very brief but of high amplitude. Though they require much more power than the body of the music, they last but a fraction of a second, and distortion would, in these brief periods, be virtually inaudible.

Thus, peak-power rating was based on the premise that an amplifier with a given rms rating could amplify transients equal to the peak voltage of the sine wave used for continuous power ratings, or 1.414 times the sine-wave voltage. Since power is equal to the square of the voltage divided by the load resistance (E^2/R) and the peak voltage is 1.414 (the square root of 2) times the sine-wave voltage, the peak power rating of an amplifier was normally set at double its continuous power output. Some amplifiers have appeared with peak ratings up to almost three times the normal undistorted output rating because of conservative continuous power rating published by the manufacturer.

Recently there have been sporadic attempts to set up standards for the high-fidelity industry. Though slowed down by the differences of philosophy between the components makers and the package hi-fi manufacturers (and even within these groups), some progress has been made. The Institute of High Fidelity Manufacturers has issued a booklet, *IHFM Standard Methods of Measurement for Amplifiers*,[1] which will probably be of great use in standardizing methods of measurement, and therefore ratings of amplifiers.

The 8-page booklet sets forth standard laboratory conditions, beginning with power-line specifications (voltage and frequency), temperature, signal input, loads and so on, and rates a power amplifier in terms of continuous power output, *music-power output*, power bandwidth and sensitivity.

Continuous power output is defined as "the greatest single-frequency power that can be obtained for a period of not less than 30 seconds without exceeding rated total harmonic distortion when the amplifier is operated under standard test conditions" (as laid down in the standard).

Music power output is "the greatest single-frequency power that can be obtained under standard test condtions without exceeding rated total harmonic distortion except that the measurement shall be taken immediately after the sudden application of a signal and during a time interval so short that supply voltages within the amplifier have not changed from their no-signal values."

Since it is impractical to measure power output and distortion under such an instantaneous condition, the IHFM specification provides that music power output shall be measured in the same way as indicated for continuous power output "except that the significant supply voltages shall be maintained at the same value as they were under no-signal conditions." The only way this can be done is to substitute temporarily a voltage-regulated power supply for the one built into the amplifier and adjust it for the proper voltage. Then the amplifier signal input is increased (from the previously measured continuous-power-output level) until the measured distortion is the same as the rated maximum for continuous output. This higher output power level is the *music power* output rating, since it is presumed to represent the *instantaneous* power output which the amplifier can handle on transient musical peaks, or the complex waveforms handled in ordinary music.

In comparing the specifications of two amplifiers with equal music power ratings, the one with the better regulated power supply would presumably show a higher continuous power rating than the amplifier with a poorly regulated cheaper power supply. It is also likely that the better regulated job's distortion vs. power output curve would be relatively flat up to the rated continuous power output level, while that of the poorer regulated amplifier would show a rapidly increasing distortion rate toward the rated continuous power level.

Power bandwidth is rated as the range between the lowest and highest frequency at which rated single-tone distortion is equaled, with the measurement made 3 db below rated continuous power output. This is a valuable standard. In the past some makers have stated frequency response in terms of the highest and lowest frequencies at which their amplifiers deliver full power at rated distortion, while others have shown frequency response curves at only 1 or 2 watts power.

The IHFM committee feels that specification of power bandwidth this way is superior to the possible conflict with IM measurements. The latter (SMPTE method) are strictly a measure of low-frequency distortion, but the frequency has never been standardized—it may be 60, 70, 100 cycles or some other choice. Standardizing this frequency might be unfair to some amplifiers. The power bandwidth figure shows clearly at what frequency the power begins to fall off, as compared to the mid-frequency power at rated distortion.

The standard also specifies conditions for measuring voltage output, distortion, hum and noise, damping factor and frequency response, both flat and equalized.

The IHFM has provided a starting point sorely needed in issuing this Standard on Amplifier Measurements (it has issued a similar one on Tuners, also $1). EIA is preparing to adopt a standard similar at least nominally to the IHFM's music power output. END

[1] Institute of High Fidelity Manufacturers, Inc., 125 E. 23rd St., New York 10, N.Y. $1.

Several audio dealers in the New York City area report increasing use of tapes for A–B demonstration of stereo sound systems. Leonard Radio Co., active in recorded tape since early two-track days, has been featuring the Mercury *1812 Overture* (STD-90054) in their component department. In its package console department, Leonard Radio favors the exaggerated separation of RCA tape *Winterhalter Goes Latin* (CPS-156) when introducing stereo to the novice. At Arnold Audio in midtown Manhattan, the current classical demo tape is Everest's four-track *Francesca Da Rimini* (STBR-3011). Top choice in pop reels—Roger Williams' Kapp release of *Rhapsody in Blue* (KT-41008). The featured stereo disc at Perdue Radio Co. is RCA LSC-2302, *Gilbert and Sullivan Overtures.*

new DISCS and TAPES

STEREO and MONO

Reviewed by
Chester Santon
Station WQXR
New York City

Music Hall Bon-Bons
Raymond Paige conducting Radio City Music Hall Symphony Orchestra
Everest Stereo Tape (4-track, open reel) STBR-1024 (7-inch; playing time, 37 min. $7.95)

***Technical Rating:* EXCELLENT**

The arrangements featured on this tape by the resident orchestra of the "nation's showplace" will jolt few listeners with their originality, but popular tunes and novelties such as *Toy Trumpet* and *Fiddle Faddle* sound far more interesting in spacious acoustics. The uniquely distinct stereo separation possible on tape is a big asset. The highs are a pleasure—flat out to the upper limit of the new playback head. The earlier stereo disc version of this same recording lacks the transparent sweetness of this tape.

GERSHWIN: *Rhapsody in Blue*
An American in Paris
Heindorf conducting Warner Bros. Symphony Orchestra
Warner Bros. Stereo Tape (4-track, open reel) BST-1243 (7-inch; playing time, 32 min. $7.95)

***Technical Rating:* POOR**

Gershwin gets a decidedly glib treatment in this Hollywood sound-stage recording with pianist Bert Shefter featured in the *Rhapsody*. The tape's recording curve may prove somewhat puzzling to owners of a wide-range playback system. Treble pre-emphasis normally found in the region of 10,000 cycles occurs here in the mid-frequencies. The huge peak intrudes upon the stereo illusion whenever fortissimo level is approached. Recording equalization almost as arbitrary as this is found in quite a number of the early four-track open-reel tapes.

STRAUSS: *Don Quixote*
Till Eulenspiegel
Rudolf Kempe conducting Berlin Philharmonic Orchestra
Capitol Stereo Record SG-7190

***Technical Rating:* EXCELLENT**

German engineers have evolved a highly successful formula for stereo recording of the Richard Strauss panoramic tone poems. The EMI mike pattern delivers completely convincing stereo in the live concert halls favored in Germany. Check the episode wherein the orchestra describes the charge of *Don Quixote* upon a flock of sheep. Stereo, as miked here, gives you a sense of movement as sounds of instruments imitating the sheep scatter in all directions. The audio quality is very impressive, placing this disc among the top recordings of 1959.

BEETHOVEN: *Symphony No. 5 in C*
Fritz Reiner conducting Chicago Symphony Orchestra
RCA Victor Stereo Record LSC-2343

***Technical Rating:* EXCELLENT**

RCA has the most exciting stereo version of the *Fifth* currently on the books. If you like your Beethoven played with lithe discipline in a wide-awake hall, investigate this one.

SMETANA: *Ma Vlast*
Rafael Kubelick conducting Vienna Philharmonic Orchestra
London Stereo Records (2) CSA-2202

***Technical Rating:* EXCELLENT**

Most catalogs list these six symphonic poems as *My Fatherland*. With a leading Czech conductor on the podium, London has released the first stereo recording of Bedrich Smetana's musical evocation of the legends and battles in the history of his native land, Czechoslovakia. Technically and musically, this is one of the most powerful stereo recordings, surpassed only by London's pace-setting opera albums. In the sections of the score that deal with the Hussite wars, transients of the full orchestra are remarkably clean even at high volume levels.

BACH: *St. Matthew Passion*
Mogens Woldike conducting Soloists, Vienna Chamber Choirs and Vienna State Opera Orchestra
Vanguard Stereo Records (4) BGS-5022/25

***Technical Rating:* EXCELLENT**

Selecting a four-record acquisition is seldom an easy choice in the stereo price range. Vanguard has met the consumer part of the way with an introductory offer—$17.85 for their version of the *St. Matthew Passion*. Despite the great difference in price, this Vanguard set stands up well in the company of the competing premium-priced German import on the Archive label.

Dinah, Yes Indeed
Dinah Shore and Nelson Riddle Orchestra
Capitol Stereo Record ST-1247

***Technical Rating:* GOOD**

In her first Capitol album, stereo emphasizes Dinah Shore's easy command of Southern charm. Nelson Riddle's arrangements mirror her personality both in intimate ballads and softly swinging production numbers.

No One Cares
Frank Sinatra and Gordon Jenkins Orchestra
Capitol Stereo Record SW-1221

***Technical Rating:* GOOD**

Separate equalization in the stereo channels is a handy feature when playing this Sinatra best-seller. The Voice, in this collection of ballads devoted to loneliness, is heard in a center position with strings massed in the left channel. Occasional woodwind and horn passages appear in the right lane. At a level high enough to give body to all of the strings, the right channel's normal groove noise becomes audible when the wind instruments are silent. By altering equalization for that individual channel, it's possible to reduce noise without excessive loss in the range of the winds.

Just For Kicks
Bob Thompson Orchestra and Chorus
RCA Victor Stereo Record LSP-2027

***Technical Rating:* EXCELLENT**

The stratospheric tinkle, plunk and tzing of upper percussion put this release into a special category. Deep cellar work of the instruments is equally effective. Novel use of voices in nonchalant pop tunes is sure to capture interest wherever stereo is on display.

French Overtures
Franz Andre conducting Belgian National Radio Orchestra
Telefunken Stereo Record TCS-18016

***Technical Rating:* GOOD**

This is the first stereo disc I've heard that does not adhere to the 500-cycle turnover of the RIAA recording curve. On my setup, some selections on the record require 300-cycle bass turnover for proper equalization. The orchestra displays ease in familiar overtures by Berlioz, Auber and Herold. The $2.98 price tag earns this one its "good" rating.

Note: Records below are 12-inch mono LP and play back with RIAA curve unless otherwise indicated.

TCHAIKOVSKY: *Serenada for Strings*
ARENSKY: *Variations on a Theme by Tchaikovsky*
Antal Dorati conducting Philharmonia Hungarica
Mercury MG-50200

***Technical Rating:* GOOD**

These are incisive performances by one of Mercury's better orchestras. Melody is the strong point in both compositions and Dorati keeps it flowing. The string choirs balance out nicely under the jurisdiction of the single omnidirectional microphone.

CHOPIN: *Sonata No. 3 in B Minor*
Vladimir Ashkenazy, Pianist
Angel 35649

***Technical Rating:* EXCELLENT**

Chopin's last sonata receives its most realistic recording to date in this Angel mono release featuring the brilliant 22-year old Russian pianist. Earlier mono versions of this work, even when played through two channels, fall behind this disc in dynamic range and clarity of detail. Side two offers a Chopin barcarolle, a pair of waltzes and a pair of mazurkas.

Son of Gunn
Shelly Manne and His Men
Contemporary M-3566

***Technical Rating:* EXCELLENT**

Drummer Shelly Manne introduces his latest jazz group in this new installment of music from the Peter Gunn TV series. Exemplary sound for light listening. END

Name and address of any manufacturer of records mentioned in this column may be obtained by writing Records, RADIO-ELECTRONICS, *154 West 14 St., New York 11, N. Y.*

Part II—Distortion in transistor amplifiers and what to do to keep it down

TRANSISTORS IN AUDIO

By HERBERT RAVENSWOOD

WHEN, individually, we first "discover" amplification for ourselves, there is invariably some romance about it. Many of us can barely remember the first time we put a tube circuit together and found the magic of amplification. But now, when we first put that little transistor into a circuit and find it amplifying—giving both current and voltage gain, as we discovered in the first part of this series—the magic is there, all over again.

Next, having gloated over our success, we want to put the amplification to work. It looks good on the scope, provided you keep input resistance fairly well up. But when you *measure* distortion, it is not good enough for high-fidelity applications. It is wonderfully convenient, economical and compact for such things as hearing aids and baby-alarm amplifiers, where all you do is amplify the sound, but where you need quality. . . .

This state of mind is right where most high-fidelity manufacturers are at present: "Transistors are ideal for some applications," they say, "but they are not suitable for high fidelity because of their distortion and noise." Let's take one thing at a time and concentrate on distortion.

Measuring distortion

Transistors have no monopoly on nonlinearity. A tube with a working gain of 70 or so produces at least 5% distortion. Unless conditions are optimum, it can produce more than that. So let's see what we can do with transistor distortion. But first we'll need to measure it to know which way we're going, because even 5% of second harmonic on an oscilloscope waveform *looks* pretty good. Many readers don't have a harmonic or IM distortion meter, so here's a good way to make such measurements without one.

It is a very simple setup, using an oscilloscope as the indicator (see Fig. 1), and most convenient for the calculations if you arrange to have the input signal voltage equal to the output signal voltage—or at least for the parts fed to the measuring circuit. The method consists of bucking the input against the output, so you can measure what's left, which is the distortion produced in between.

First adjust the input to the transistor by setting R1 for the desired output level at point A. Now adjust R2 to get the same voltage at point B. With switch S set on CALIBRATE, adjust the scope's vertical and horizontal gain so the trace is a 45° line, the ends of which coincide with major horizontal and vertical rulings on the graticule.

Now switch S to MEASURE and adjust R3 (NULL BALANCE) until the line becomes horizontal. (The 47,000-ohm resistors make the adjustment of this pot less critical.) Finally step up the gain of the scope's vertical amplifier with its decade switch, and you can read off the percentage of distortion as follows:

If you set the 45° line so it measured 20 divisions each way, the vertical height of the trace on the null balance will represent 0–20% (or 1% per division) for the first-decade stepup in gain. The second gives you a range of 0–2% (or 0.1% per division). If the height of your original 45° line was other than 20 divisions, the readings will be proportionate, but using 20 divisions is convenient.

Because we made the input and output voltages the same, the null point will be where the resistances measured from points A and B to the slider of R3 are equal. This will null the part of the output signal that corresponds *exactly* with the input. The part that does not cancel is distortion. As point A has the distortion and point B does not (it is our reference "pure" input), R3's slider shows just half the distortion at A. So, without altering the scope's vertical gain, the vertical scale (which we made 20 divisions) represents 200% distortion. Other positions of the vertical decade switch correspond, as before. If the input and output voltages are not equal, as we have assumed, you can still use this method, but the calculations get more involved.

Fig. 2 shows some of the displays and what they indicate. If the display slants, balance is not quite right and R3 needs further adjustment to get the reading. If it opens out into a loop as it swings from one slant to the other, there is a phase shift between input and output. This is overcome by changing the frequency until input and output are in phase (usually somewhere between 200 and 1,000 cycles) or by introducing a phase-compensating capacitor (see Fig. 3), usually a small trimmer. (Connect it across the side of the potentiometer that gives phase correction, instead of increasing the error, as determined by experiment.)

If you are interested only in distortion characteristic, it is easier to adjust the frequency. Later on when you want to investigate the dependence of distortion on frequency, you will have to use

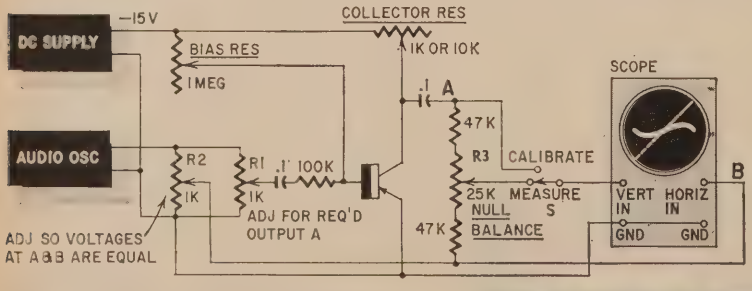


Fig. 1—Using scope balancing method to measure transfer distortion of unloaded transistor stage.

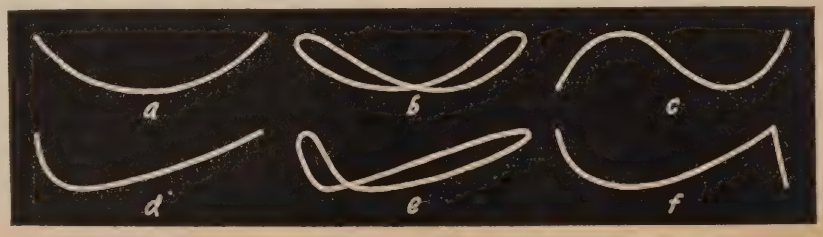
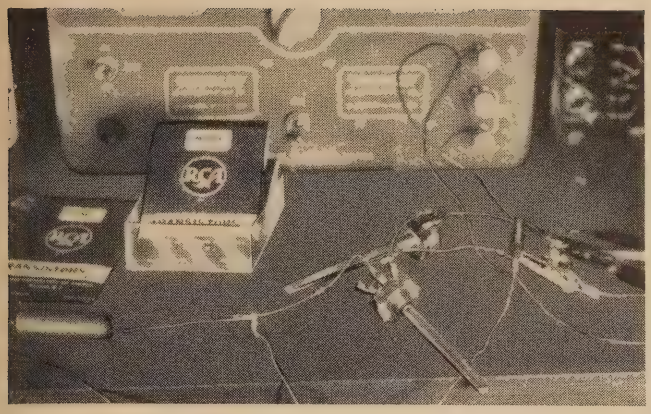


Fig. 2—Some of the traces obtained in the balanced condition: a—pure second harmonic; b—second harmonic with some phase shift; c—pure third harmonic; d—second and higher order; e—same as d with phase shift; f—curvature at one end, clipping at other.



One of Mr. Ravenswood's breadboard type setups.

the method of phase compensating.

Now let's measure

So now to the 2N109's. Let's go back over the set of conditions we explored before and see how the distortion figures show up. The results are tabulated in Table I. The lowest distortion occurs with the highest collector resistors, and the highest with the lowest collector resistors. But remember, this is without coupling the stage we are measuring to another following one, which will load down the collector considerably.

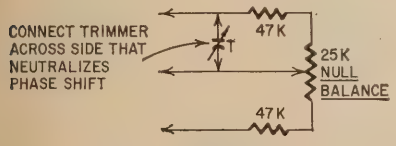


Fig. 3—Balance circuit modification eliminates phase shift between input and output.

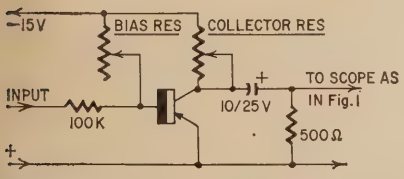


Fig. 4—Adding a resistance load to the transistor output changes the figures.

Assume the following stage's base input resistance averages 500 ohms. It is a nonlinear resistance but, as we are measuring the voltage across it, we can come nearest to predicting the overall result here by substituting a 500-ohm resistor, because it is the *current* delivered to the next base that matters. In a linear resistor, voltage indicates current waveform as well.

If we shunt the collector with a 500-ohm load, coupling it through a capacitor (see Fig. 4), several changes must be made. Current gain is reduced somewhat, and the voltage output corresponding to the same current swing is smaller, so we have to work out different voltage readings to use.

With the same bias, distortion sets in rather early, but can be held off by using a different bias, yielding lower collector voltage and higher current. This can be found by adjusting the bias until a reasonably straight line of maximum length can be obtained on the screen.

The specific magnitude of these changes, using the same range of collector feed resistors as in Table I, is given in the tabulation of Table II, which was made after adjusting with the 500-ohm coupled load.

The frequency must be raised slightly to get a balance in making the distortion measurement, because of the phase shift produced by the output coupling capacitor, which was not present before.

Here we see a pattern emerging. With high values of collector resistance, the bias has to bring the collector voltage down (and current up) to get maximum swing, which is still small. But the current gain is relatively high and the distortion small.

With lower-value collector resistors, the bias must still bring the collector lower than the open-circuit operation, but not as much as for the higher resistance. Current gain is lower, handling capacity (which in transistors is measured in *current swing*, not the more familiar, voltage swing of tubes) and distortion are higher, although coupling to the load reduces the distortion compared with the same collector resistor working open-circuit (compare with Table I).

But so far we have fed the input base with a very high resistance, as a matter of convenience. We get more gain (particularly from a voltage source) by using a lower resistance—up to a point, anyway. For input stages, at least, it will prove instructive to measure the input impedance distortion using different values of series resistance. A convenient way to do this is shown in Fig. 5.

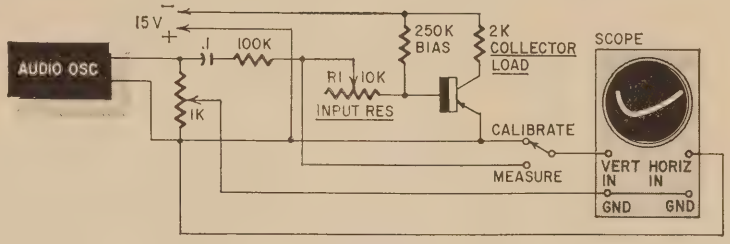


Fig. 5—Setup to measure the input base impedance with different series base resistors, on a sinusoidal current basis.

Input-impedance distortion

The original 100,000-ohm input resistor maintains essentially sinusoidal input current. Different values of series resistance are inserted between it and the transistor's base with potentiometer R1. The voltage is measured across this junction (from R1's slider to ground), from which the impedance can be deduced. But, most important, the nonlinearity of the voltage indicates the nonlinearity of the overall input impedance.

Similarly if the voltage were sinusoidal, the current would be nonsinusoidal. The results of a sequence of tests is given in Table III. Incidentally, using this circuit, the percentage of harmonic distortion reads directly, because here there is no division of the harmonic-content component by the balancing arrangement.

TABLE I

Collector resistor (ohms)	10K	8K	6K	4K	3K	2K	1K	500	250
Dc collector volts	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Output volts	4.7	5	5	4.8	4.9	5.1	4.9*	5*	5*
Bias resistor (ohms)	1M	800K	630K	440K	350K	250K	160K	90K	48K
Bias current (μa)	15	18.7	24	34	43	60	94	167	312
Current gain (as before)	47	50	50	48	49	51	68	68	58
Distortion (%)	1.7	1.75	2	2.5	4	6	7	7.5	15.5

*Using a reduced value input resistor to get enough drive.

TABLE II

Collector resistor (ohms)	10K	8K	6K	4K	3K	2K	1K	500	250
Dc collector volts	1.5	1.6	1.8	2.1	2.3	2.6	3.5	4	4.8
Output volts	0.35	0.45	0.6	0.8	1.1	1.5	2.2	3.2	3.9
Bias resistor (ohms)	750K	650K	520K	375K	300K	225K	125K	60K	30K
Bias current (μa)	20	23	29	40	50	67	120	250	500
Current gain (into 500 ohms)	5	6.5	9	14	20	32	52	36	20
Distortion (%)	1.7	1.7	1.9	2.3	3.5	5	6.5	10	14.5

TABLE III

Series feed resistor, 100,000 ohms
Collector resistor, 2,000 ohms
Input current held at 50μa, by keeping input at 5 volts

Value of series base resistor (ohms)	0	500	1K	2K	3K	5K	10K
Input at base resistor (mv)	45	68	92	138	187	285	535
Impedance (ohms)	900	1,360	1,840	2,760	3,740	5.7K	10.7K
Distortion (%)	32	21	15	10	7.5	5	2.5

TABLE IV

Input voltage sinusoidal (not thru 100K)
Collector resistor, 2,000 ohms
Output adjusted to 5 volts

Series base resistor (ohms)	50	500	1K	2K	3K	5K	10K	20K	50K	100K
Distortion in base current (%)	38	33	27	19	14	9	4.6	2.5	1.0	0.5
Collector voltage distortion (%)	33	27	21	17	12.5	7.8	4.5	3.5	5	6

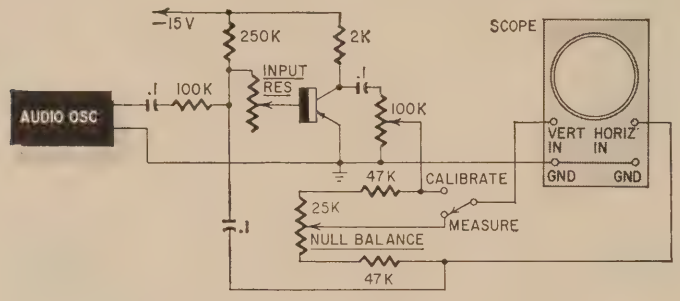


Fig. 6—Measuring input-to-output distortion for voltage input with sinusoidal current.

But how does this input-impedance distortion combine with the gain-stage distortion that follows it? If the input is a *voltage* source (which is far more usual than a current source), we can check this by picking off the input to balance against the output at this junction (see Fig. 6) or, better still, use the proposed value of input resistance directly from a true voltage source (see Fig. 7). Table IV gives the quantitative results.

From this investigation it appears that the input impedance distortion "rounds" one end of the wave, while the transistor transfer characteristic (amplification) tends to round the other (see Fig. 8). One might imagine that these opposite curvatures would tend to cancel. To a very slight extent they do. The overall result is that, instead of producing second- and higher-order *even* harmonics, which each does by itself, the combination produces some odd harmonics, particularly third, with some fifth. These components become largest when the cancellation is doing its best to reduce second.

Thermal runaway

So far we have merrily put in transistors, changed values, adjusted bias and taken our readings. Last month we found that the bias had to be adjusted differently, for almost each transistor, at least using this simple biasing circuit. For a reliable circuit, something better is needed. Added to this, especially in the higher-current conditions (lower-value collector resistors) there is a tendency to thermal runaway.

Transistor operating characteristics change with temperature. When higher currents are used, the transistors get warm. This increase in temperature boosts the transistor's gain. At the same time, the same base bias produces a larger collector current. This increases the temperature still further, building up the effect into a runaway that finishes with a pop and a cloud of smoke as the transistor burns out.

What can we do to offset variations between individual transistors and to prevent thermal runaway? One thing is to connect the other end of the bias resistor to the collector instead of the negative supply (positive with n-p-n types). Suppose the operating conditions are 5 volts at the collector, drawn from a 15-volt supply, through a 1,000-ohm collector resistor, giving 10-ma collector current and requiring 150-μa bias. The dc gain of the transistor (not taking the *coupled* load into account) is 70. For bias from the negative supply, the resistor has to be 100,000 ohms (15 volts, 150 μa). But for bias from the collector (see Fig. 9) the resistor has to drop only 5 volts, instead of 15 volts, with its 150 μa requiring a 33,000-ohm resistor.

Now suppose the transistor changes (or we use a different sample transistor) so that 150 μa finds a condition of (a) 4 volts at 11 ma, or (b) 6 volts at 9 ma at the collector. With the bias taken from the supply point, this would be the new operating condition. But with bias taken from the collector, the bias changes from 150 μa to (a) 4/5 × 150, or 120 μa, or (b) 6/5 × 150, or 180 μa. With a gain of 70, this 30-μa change in bias current will change the collector current by 70 × 30, or 2.1 ma, in the same direction.

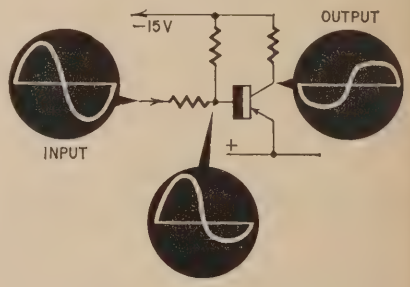


Fig. 8—Relationship between distortions due to base input resistance and nonlinear amplification.

In case (a), reduction from 11 to 8.9 ma would raise the collector voltage to 6.1. Of course this has gone further in the opposite direction than we started. Actually it is negative feedback. It reduces the deviation by more than 6 db, so the variation will be cut from 1 volt either way to about 0.45 volt. This is better, but whether it is better *enough* depends on our requirements. If more is needed, other tricks can be tried in various combinations.

One step we can use has several advantages. This is a small resistor in the emitter lead (see Fig. 10). It is a useful way of increasing the effective base input resistance *and* linearizing it. This property can be measured as before (see Fig. 6), but using no series input resistor, so only the bare base input resistance is determined, both in value and distortion effect. These results are tabulated in Table V.

Approximately, the input resistance under this arrangement can be regarded as the original nonlinear base input resistance, augmented by a resistance equivalent to the actual resistance in the emitter lead *multiplied*

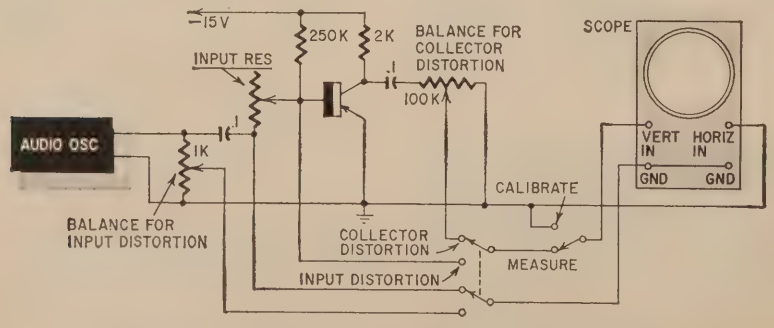


Fig. 7—Measuring input current distortion and output distortion with sinusoidal input voltage.

by the working current gain of the transistor.

This resistor also has a linearizing effect on the amplification characteristic without measurably reducing its *current* gain. This also is shown in Table V. Of course it reduces its effective gain from a *voltage* input, because it raises the effective input resistance.

This improvement may be explained as follows: Suppose that current gain is reduced during one part of the waveform, due to closing up of the curves (base and collector). This results in a smaller feedback voltage across the emitter resistance or a drop in the working current gain. The factor which the input resistance (effectively) is multiplied by falls, and the input accepts a larger signal current swing for the same voltage swing, thus offsetting the reduction in current gain during this part of the waveform.

Another advantage of the emitter resistor is the way it helps out on another trick. The effect of bias resistor feedback can be increased by using a smaller resistor. But this would produce

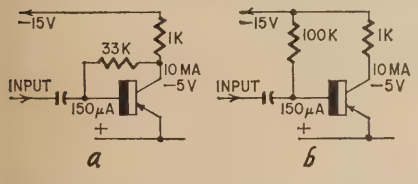


Fig. 9—Improved stability is obtained by using bias from collector (a) instead of the negative supply (b).

the wrong bias, unless something else is done. If bias current is 150 μa, we could improve this by halving the bias resistor, and then providing for the "spare" 150 μa to go to ground.

Without an emitter resistor, the base-to-ground (emitter) voltage at the operating point is probably no more than about 50 mv, which means the resistor to take the odd 150 μa has to be only about 330 ohms (see Fig. 11-a). This has to be a dc path, and thus is an effective part (in parallel) of the source resistance feeding the base. As our figures have shown, this produces considerable distortion due to the nonlinear base input resistance.

Now suppose we have a 47-ohm resistor in the emitter. With a 10-ma collector current this will drop 470 mv, raising the required base voltage to 520 mv (the original 50 mv plus the 470). As well it will add 70 × 47, or 290 ohms, to the input resistance, also linearizing current gain. But now, to increase the effectiveness of the bias feedback, the input shunt resistor (Fig. 11-b) has to drop 520 mv with the extra 150 μa, also requiring an actual resistance of about 3,300 ohms.

If we are working from a high-resistance source (compared to these values), this will drop the gain by another 6 db (in addition to the loss because of the bias feedback) due to the current division between the 3,300-ohm actual resistor and the effective 3,300-ohm input

TABLE V

CURRENT BASIS: Input, 5 volts; **Input resistor,** 100,000 ohms; **Input current,** 50 μa; **Collector resistor,** 2,000 ohms; **Output,** 5 volts							
Emitter resistor (ohms)	0	10	20	30	50	100	200
Base input (mv)	45	68	92	115	162	285	535
Input impedance (ohms)	900	1,360	1,840	2,300	3,840	5,700	10.7K
Distortion at collector (%)	6	6	6	6	6	6	6
VOLTAGE BASIS: Input resistor, 50 ohms (to measure current); **Output,** 5 volts; **Collector resistor,** 2,000 ohms							
Emitter resistor (ohms)	0	10	20	30	50	100	200
Current (μa)	49	50	50	50	50	50	50
Base input (mv)	88	110	125	140	165	285	535
Input impedance (ohms)	1.8K	2.2K	2.5K	2.8K	3.3K	5.7K	10.7K
Distortion at collector (%)	33	22	15	12	8	4.5	2.5

base resistance (which now is quite reasonably linear). On the other hand, working from a voltage source, the overall input resistance will be the two 3,300 ohms in parallel, and the linearity will be quite good. Bigger swamping of the nonlinear base resistance would make it better.

Actually, though, the emitter resistance by itself will stabilize and linearize, without sacrificing effective *current* gain, so that collector-connected bias stabilization may be unnecessary. Take the previous supposition, but use 50,000 ohms from supply minus, instead of about 15,000 ohms from the collector, with 3,300 ohms from base to ground. Normal condition is 150-μa base current, 150 μa through the 3,300-ohm 520-mv base to ground, 470 millivolts emitter to ground.

Now suppose the collector current changes (due to change of transistor or its characteristics) to 9 or 11 ma. The emitter-to-ground voltage will change to 420 or 520 mv. By the time the base voltage changes to suit, the 3,300-ohm resistor from base to ground will be taking more or less than its share of the 300 μa from supply minus, and the difference will be bringing the bias point back nearer where it ought to be.

With the bias resistor set to pass twice the required bias current (half bypassed to ground), the best stabilization that can be achieved this way is 6 db. But this can be improved by using

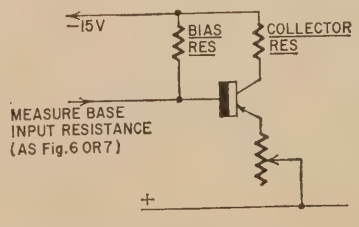


Fig. 10—Inserting emitter resistance linearizes base input resistance (and raises it) without affecting current gain. For voltage input it also linearizes gain distortion.

a larger emitter resistor (47 ohms is still very small compared to other circuit values) and by allowing the base-to-ground resistor to bypass more than a current equal to the bias current.

Thus we have quite a variety of things we can change. The best choice will depend on a number of things—input source resistance; other things

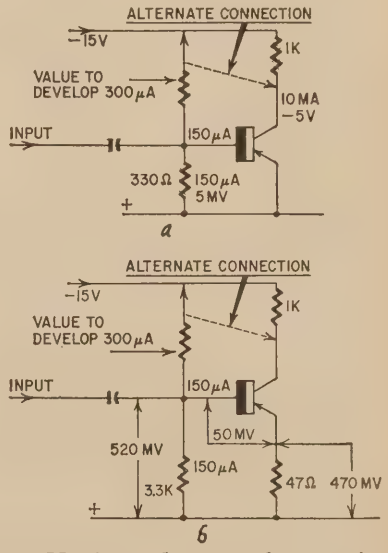


Fig. 11—How the use of an emitter resistance also aids the stabilizing problem by allowing the use of a practical value of base-to-ground resistance.

that may want to be included, such as equalizer circuits, and so on. We are already beginning to see that, although transistors (to date) have only three electrodes, they are at least as versatile as tubes with more. While there are a few things tubes will do that are difficult with transistors, it looks as if we may end up the other way, with transistors doing many jobs that tubes cannot handle.

Meanwhile we have plenty more to explore in transistors in the realms already discovered. More of that next time.

TO BE CONTINUED

New Transistor Clock Radio Kit

EVERYTHING A CLOCK-RADIO CAN OFFER . . . AND PORTABLE TOO!

- Completely portable, all-transistor circuit
- Runs up to 500 hours on standard batteries
- Deluxe features at half the cost
- Easy to assemble

HEATHKIT TCR-1
$45.95

"YOUR CUE" TRANSISTOR CLOCK RADIO KIT (TCR-1)

Take all the deluxe features found in the most expensive clock-radios, add the convenience of complete portability, plus a modern 6-transistor battery operated circuit . . . then slash the price at least in half, and you have the new Heathkit "Your Cue" Transistor Portable Clock Radio.

Packing every modern clock-radio feature into a compact, beautifully styled turquoise and ivory plastic cabinet, "Your Cue" lulls you to sleep, wakes you up, gives you the correct time and provides top quality radio entertainment in and out-of-doors. It can also be used with the Heathkit Transistor Intercom system, opposite page, to provide music or a "selective alarm" system for one or more rooms covered by the intercom system.

An "Alarm-set" hand, hour hand, minute hand and sweep second hand grace the easy-to-read clock dial. All controls are conveniently located and simple to operate. The "lull-to-sleep" control sets the radio for up to an hour's playing time, automatically shutting off the receiver when you are deep in slumber. Other controls set "Your Cue" to wake you to soft music, or conventional "buzzer" alarm. A special earphone jack is provided for private listening or connection to your intercom or music system. At all times crystal-clear portable radio entertainment is yours at the flick of a switch.

The modern 6-transistor circuit features prealigned IF's for ease of assembly. A tuned RF stage and double tuned input to the IF stage assure top performance. The built-in rod-type antenna pulls in far-off stations with outstanding clarity while a large 4" x 6" speaker provides tonal reproduction of unusual quality.

Six easily obtainable penlight-size mercury batteries power the radio receiver up to 500 hours, while the clock operates up to 5 months from a single battery of the same type. Ordinary penlight cells may also be used with reduced battery life.

The handsome two-tone cabinet, measuring only 3½" H. x 8" W. x 7½" D. fits neatly into the optional carrying case for beach use, boating, sporting events, hunting, hiking, or camping.

Wherever you are, you'll find "Your Cue" your constant companion. Shpg. Wt. 5 lbs.

LEATHER CARRYING CASE
HEATHKIT
NO. 93-3
$4.95
Shpg. Wt. 2 lbs.

HEATH COMPANY/Benton Harbor, Mich.

a subsidiary of Daystrom, Inc.

New Transistor Intercom Kit

TALK WITH ANY OR ALL FIVE STATIONS WITH YOUR OWN INTERCOM SYSTEM

- Battery Power Permits Placement Anywhere
- Versatile Unit has Many Important Uses
- Complete Privacy of Conversations Assured

TRANSISTOR INTERCOM KIT (XI-1 and XIR-1)

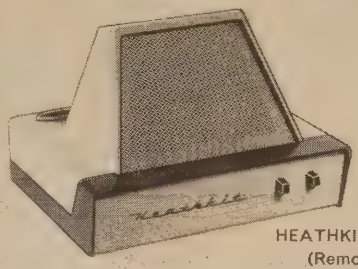
A flexible, versatile transistor intercom, has been developed by Heath engineers to enable you to set up your own communications system at an unbelievably low price.

Consisting of a master unit (XI-1) and up to five remote stations (XIR-1), the system is designed for any remote unit to call the master, for any remote station to call any other remote station, or for the master unit to call any single remote unit or any combination of remote units. Complete privacy is assured, since a call to a remote station cannot be interrupted or listened to while the remote unit is in operation unless switched in by the master unit. Used with clock-radio, opposite page, it can serve as a music or "selective alarm" system.

Transistor circuitry means long life, instant operation and minimum battery drain. Eight ordinary, inexpensive "C" flashlight batteries will run a unit for up to 300 hours of normal "on" time. Circuitry is especially designed for crisp, clear intelligible communication and the instant operation feature allows tuning of the units off between calls, extending battery life. Use of battery power does away with power cords, allowing each unit to be placed where most convenient. Only two wires are required between the master unit and each remote station. Beautifully styled, the Heathkit Intercom presents a new approach in design. Both master and remote stations have two-piece cases in ivory and turquoise for a rich, quality appearance. Batteries not included. Shpg. Wt. 6 lbs.

HEATHKIT XI-1 (Master)

$27.95



HEATHKIT XIR-1 (Remote)

$6.95

Shpg. Wt. 4 lbs.

AC POWER SUPPLY (XP-1)

A permanent power supply for 24-hour operation of the XI-1 Intercom on household current. Converts 110 V. AC to well filtered 12-volt DC output, eliminating the need for batteries. Power supply is small, compact and fits in space normally occupied by batteries.

HEATHKIT XP-1 ..... $9.95

NEW IMPROVED DESIGN

STEREO-MONO PREAMP KIT (SP-2A, SP-1A)

Get the SP-2A Stereo Preamp kit now, or the SP-1A monophonic version which you can easily convert to stereo whenever you choose by assembling the second channel (C-SP-1A) and plugging it into your SP-1A.

The SP-2A permits stereo, two channel mixing, or either channel monophonic use, and includes a remote balance control.

Six inputs (12 in the stereo version) accommodate tape, magnetic phono and microphone, plus three separate high level inputs. Level controls provided on "mag. phono" and high level inputs. Switch selects NARTB equalization for tape head input, and RIAA, LP or 78 RPM compensation for mag. phono input

HEATHKIT SP-1A (monophonic) Shpg. Wt. 13 lbs. $37.95

HEATHKIT C-SP-1A (not shown) (converts SP-1A to SP-2A) Shpg. Wt. 4 lbs. $21.95

New

HEATHKIT SP-2A (stereo)
Shpg. Wt. 15 lbs.

$56.95

$5.70 down, $6.00 mo.

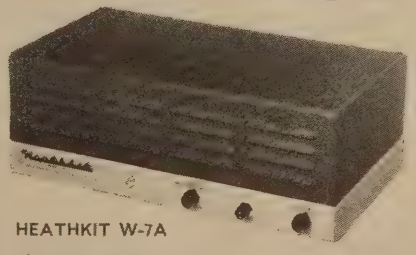
THE WORLD'S BIGGEST BARGAIN IN A HI-FI AMPLIFIER

New

55 WATT HI-FI AMPLIFIER KIT (W-7A)

Utilizing advanced design in components and tubes to achieve unprecedented performance with fewer parts, Heathkit has produced the world's first and only "dollar-a-watt" genuine high fidelity amplifier. Meeting full 55-watt hi-fi rating and 50-watt professional standards, the new improved W-7A provides a comfortable margin of distortion-free power for any high fidelity application.

The sleek, modern styling of this unit allows unobtrusive installation anywhere in the home. The clean, open layout of chassis and precut, cabled wiring harness makes the W-7A extremely easy to assemble. Shpg. Wt. 28 lbs.



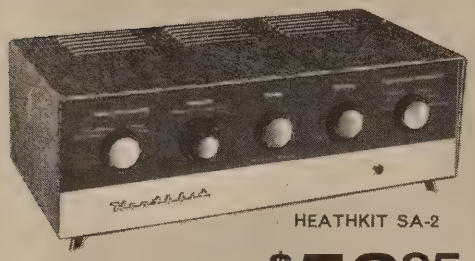
HEATHKIT W-7A

$54.95

SPECIFICATIONS—Power output: Hi-Fi rating, 55 watts; Professional rating, 50 watts. **Power response:** ±1 db from 20 cps to 20 kc at 55 watts output. **Total harmonic distortion:** Less than 2% from 30 cps to 15 kc at 55 watts output. **Intermodulation distortion:** Less than 1% at 62 watts output using 60 cps and 6 kc signal mixed 4:1. **Hum and noise:** 80 db below 55 watts, unweighted. **Damping factor:** Switch on front panel for selecting either maximum (20:1) or unity (1:1). **Output impedances:** 4, 8 and 16 ohms and 70-volt line. **Power requirements:** 117 volts, 50/60 cycles, 90-160 watts. **Dimensions:** 8½" D. x 6½" H. x 15" W.

New HEATHKIT®

Stereo Amplifiers



HEATHKIT SA-2

$52.95

YOUR BEST DOLLAR VALUE IN STEREO...

14/14 WATT STEREO AMPLIFIER KIT (SA-2)

Complete control is at your fingertips with this versatile Stereo Amplifier-Preamplifier. Providing 14 watts per stereo channel, or 28 watts total monophonic, the SA-2 offers every modern feature in a master stereo control center at a price to please the budget minded. The unit offers selection of dual channel stereo operation, monophonic operation using both channels simultaneously, or using either channel for monophonic program material independent of the other channel. A 4-position input selector switch provides choice of mag. phono, crystal phono, tuner, and high level auxiliary input for tape recorder, TV, etc. Other features include RIAA equalization on mag. phono, channel reversing function, clutched volume control, ganged dual tone controls, speaker phase reversal switch and two AC outlets. Handsomely styled black and gold vinyl-clad steel cabinet. Shpg. Wt. 23 lbs.

SPECIFICATIONS—Power output: 14 watts per channel, "hi-fi"; 12 watts per channel, "professional"; 16 watts per channel, "utility". **Power response:** ±1 db from 20 cps to 20 kc at 14 watts output. **Total harmonic distortion:** less than 2%, 30 cps to 15 kc at 14 watts output. **Intermodulation distortion:** less than 1% at 16 watts output using 60 cps and 6 kc signal mixed 4:1. **Hum and noise:** mag. phono input, 47 db below 14 watts; tuner and crystal phono, 63 db below 14 watts. **Controls:** dual clutched volume; ganged bass, ganged treble; 4-position selector; speaker phasing switch. **AC receptacle:** 1 switched; 1 normal. **Inputs:** 4 stereo or 8 monophonic. **Outputs:** 4, 8 and 16 ohms. **Dimensions:** 4½" H. x 15" W. x 8" D. **Power requirements:** 117 volts, 50/60 cycle, AC, 150 watts (fused).

New

HEATHKIT SA-3

$29.95

ECONOMY STEREO AMPLIFIER KIT (SA-3)

This amazing performer delivers more than enough power for pure, undistorted room-filling stereophonic sound at the lowest possible cost. Featuring 3 watts per stereo channel and 6 watts as a monophonic amplifier, the SA-3 has been proven by exhaustive tests to be more than adequate in volume for every listening taste.

You will find its ease of assembly another plus feature. Heathkit construction manuals, world famous for their clarity and thoroughness, lead you a simple step at a time to successful completion of the kit. Larger than life-size diagrams show you exactly what each part looks like, where it goes, and how it is installed.

The amplifier is tastefully styled in black with gold trimmed control knobs and gold screened front and rear panel. A tremendous buy at this low Heathkit price! Shpg. Wt. 13 lbs.

SPECIFICATIONS—Power output: 3 watts per channel. **Power response:** ±1 db from 50 cps, 20 kc at 3 watts out. **Total harmonic distortion:** less than 3%; 60 cps, 20 kc. **Intermodulation distortion:** less than 2% @ 3 watts output using 60 cycle & 6 kc signal mixed 4:1. **Hum and noise:** 65 db below full output. **Controls:** dual clutched volume; ganged treble, ganged bass; 7-position selector; speaker phasing switch; on-off switch. **Inputs (each channel):** tuner, crystal or ceramic phono. **Outputs (each channel):** 4, 8, 16 ohms. **Finish:** black with gold trim. **Dimensions:** 12½" W. x 6¾" D. x 3¼" H.

HEATHKIT XR-2P

(6 lbs.)

$29.95

New

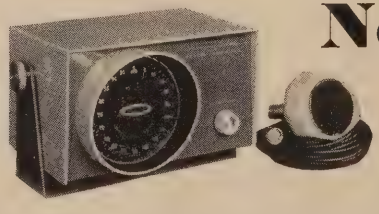
HEATHKIT XR-2L

(7 lbs.) **$34.95**

6-TRANSISTOR PORTABLE RADIOS (XR-2P and XR-2L)

New, improved styling, new vernier tuning, up to 1,000 hours on flashlight batteries . . . are just a few of the plus features you get with these new transistor portables. Carry them with you wherever you go; to the beach, on trips, boating, etc. These new, improved models bring you the outstanding performance of the preceding models plus brand new styling and the additional convenience of vernier tuning for smooth, effortless station selection. The XR-2P features a mocha and beige high-impact plastic case. The XR-2L has a sun-tan color leather case with an identical beige plastic front. Six Texas Instrument transistors are used for high sensitivity and selectivity. A large 4" x 6" PM speaker with heavy magnet provides excellent tone quality. The roomy chassis makes it unnecessary to crowd components, adding greatly to ease of construction. The six standard size "D" flashlight batteries used for power provide extremely long battery life and can be purchased anywhere. Fun to build, and fun to use . . . order one today!

New



HEATHKIT DS-1

$69.95

$7.00 DN., $7.00 MO.

- Indicates Depth and Type of Bottom From 0 to 100 Feet
- Detects Submerged Objects (fish, logs, etc.) and Their Depth
- Completely Transistorized . . . Operates From Flashlight Batteries

TRANSISTOR DEPTH SOUNDER (DS-1)

Weekend boatsman or professional . . . fisherman or skindiver . . . here's the depth sounder for you. Depth is indicated by a flashing neon lamp rotating behind a transparent circle in the molded black plastic dial face. A large hood around the dial enables the viewer to easily read the indicator in bright light or sunshine. The transducer uses a barium titanate element mounted in a faired, molded epoxy resin housing with solid brass through-hull fitting and mounting hardware. While designed for permanent mounting on the bottom of the boat, temporary outboard mounting of the transducer is also possible. The completely transistorized circuit operates from 6 flashlight cells and one long-life battery. Comes complete with splash-proof cabinet, hardware and gimbal-type mounting bracket. Shpg. Wt. 10 lbs.

New HEATHKIT® Amplifiers & Tuners

A NEW AMPLIFIER AND PREAMP UNIT PRICED WELL WITHIN ANY BUDGET

14-WATT HI-FI AMPLIFIER KIT (EA-3)

This thrilling successor to the famous Heathkit EA-2 is one of the finest investments anyone can make in top quality high fidelity equipment. It delivers a full 14 watts of hi-fi rated power and easily meets professional standards as a 12-watt amplifier.

Rich, full range sound reproduction and low noise and distortion are achieved through careful design using the latest developments in the audio science. Miniature tubes are used throughout, including EL-84 output tubes in a push-pull output circuit with a special-design output transformer. The built-in preamplifier has three separate switch-selected inputs for magnetic phono, crystal phono or tape, and AM-FM tuner. RIAA equalization is featured on the magnetic phono input. Shpg. Wt. 15 lbs.

NOTE THESE OUTSTANDING SPECIFICATIONS—Power output: 14 watts, Hi-Fi; 12 watts, Professional; 16 watts, Utility. **Power response:** ±1 db from 20 cps to 20 kc at 14 watts output. **Total harmonic distortion:** less than 2%, 30 cps to 15 kc at 14 watts output. **Intermodulation distortion:** less than 1% at 16 watts output using 60 cps and 6 kc signal mixed 4:1. **Hum and noise:** mag. phono input, 47 db below 14 watts; tuner and crystal phono, 63 db below 14 watts. **Output impedances:** 4, 8 and 16 ohms.

HEATHKIT EA-3

$29.95

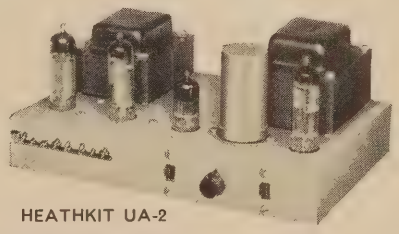
NEVER BEFORE HAS ANY HI-FI AMPLIFIER OFFERED SO MUCH AT SO LOW A PRICE

New

"UNIVERSAL" 14-WATT HI-FI AMPLIFIER KIT (UA-2)

Meeting 14-watt "hi-fi" and 12-watt "professional" standards, the UA-2 lives up to its title "universal" performing with equal brilliance in the most demanding monophonic or stereophonic high fidelity systems. Its high quality, remarkable economy and ease of assembly make it one of the finest values in high fidelity equipment. Buy two for stereo. Shpg. Wt. 13 lbs.

SPECIFICATIONS—Power output: Hi-Fi rating, 14 watts; Professional rating, 12 watts. **Power response:** ±1 db from 20 cps to 20 kc at 17 watts output. **Total harmonic distortion:** Less than 2% from 20 cps to 20 kc at 14 watts output. **Intermodulation distortion:** Less than 1% at 14 watts output using 60 cps and 6 kc signal mixed 4:1. **Hum and noise:** 73 db below 14 watts. **Output impedances:** 4, 8 and 16 ohms. **Damping factor:** Switched for unity or maximum; maximum damping factor 15:1. **Input voltage for 14 watt output:** .7 volts. **Power requirements:** 117 volts 50/60 cycles, 55 watts. **Dimensions:** 10" W. x 6½" D. x 4¾" H.



HEATHKIT UA-2

$22.95

MORE STATIONS AND TRUE FM QUALITY ARE YOURS WITH THIS FINE TUNER KIT

New

HIGH FIDELITY FM TUNER KIT (FM-4)

This handsomely styled FM tuner features better than 2.5 microvolt sensitivity, automatic frequency control (AFC) with on-off switch, flywheel tuning and prewired, prealigned and pretested tuning unit. Clean chassis layout, prealigned intermediate stage transformers and assembled tuning unit makes construction simple—guarantees top performance. Flywheel tuning and new soft, evenly-lighted dial scale provide smooth, effortless operation. Vinyl-covered case has black, simulated-leather texture with gold design and trim. Multiplex adapter output also provided. Shpg. Wt. 8 lbs.

SPECIFICATIONS—Tuning range: 88 to 108 mc. **Quieting sensitivity:** 2.5 uv for 20 db of quieting. **IF frequency:** 10.7 mc. **Image ratio:** 45 db. **AFC correction factor:** 75 kc per volt. **AM suppression:** 25 db. **Frequency response:** ±2 db 20 to 20,000 cps. **Harmonic distortion:** Less than 1.5%, 1100 uv, 400 cycles 100% modulation. **Intermodulation distortion:** Less than 1%, 60 cycles and 6 kc mixed 4:1 1100 uv, 30% modulation. **Antenna:** 300 ohms unbalanced. **Output impedance:** 600 ohms (cathode follower). **Output voltage:** nominal .5 volt (with 30% modulation, 20 uv signal). **Power requirements:** 105-125 volts 50/60 cycle AC at 25 watts. **Overall dimensions:** 4½" H. x 13¼" W. x 5½" D.

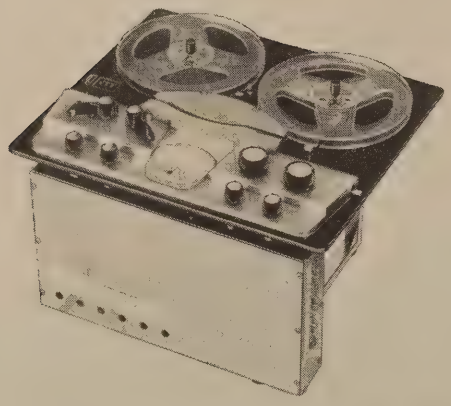
HEATHKIT FM-4

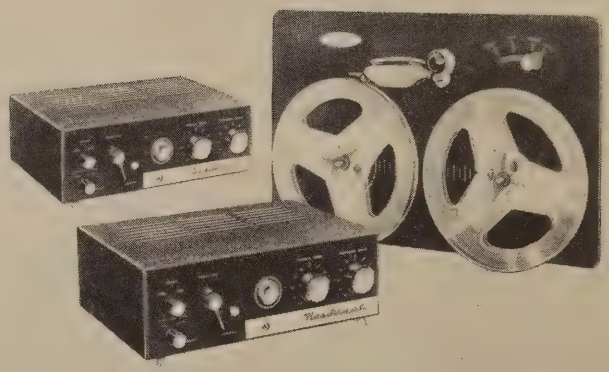
$34.95

HEATH COMPANY/Benton Harbor, Mich.

a subsidiary of Daystrom, Inc.

New HEATHKIT Tape Recorders





- Choice of 3 Outstanding Models
- Compare With $350-$400 Machines
- Preassembled Tape Mechanism
- Choice of Monophonic or Stereo models
- Complete versatility
- Easy to assemble, easy to use

PROFESSIONAL QUALITY TAPE RECORDER KITS (TR-1 Series)

Enjoy the incomparable performance of these professional quality tape recorders at less than half the usual cost. These outstanding kits offer a combination of features found only in much higher priced professional equipment, generally selling for $350 to $400. Not the least of these special features is the handsome styling which characterizes the kits . . . a semi-gloss black panel is set off by a plastic escutcheon in soft gold, which is matched by black control knobs with gold inserts. The mechanical assembly, with fast forward and rewind functions, comes to you completely assembled and adjusted; you build only the tape amplifier. And, you'll find this very easy to accomplish, since the two circuit boards eliminate much of the wiring. Separate record and playback heads and amplifiers allow monitoring from tape while recording and a "pause" control permits instant starting and stopping of tape for accurate cueing and tape editing. A digit counter is provided for convenient selection of any particular recording. Push-pull knob provides instant selection of 3¾ or 7½ IPS tape speed. Safety interlock on record switch reduces possibility of accidental erasure of recorded tapes. Shpg. Wt. 30 lbs.

SPECIFICATIONS—Tape speed: 7.5" and 3.75" per second. **Maximum reel size:** 7". **Frequency response (record-playback):** ±2.5 db, 30 to 12,000 cps at 7.5 IPS; ±2.5 db, 30 to 6,500 cps at 3.75 IPS. **Harmonic distortion:** 1% or less at normal recording level; 3% or less at peak recording level. **Signal-to-noise ratio:** 50 db or better, referred to normal recording level. **Flutter and wow:** 0.3% RMS at 7.5 IPS; 0.35% RMS at 3.75 IPS. **Heads (3):** erase, record, and in-line stereo playback (TR-1C, monophonic playback). **Playback equalization:** NARTB curve, within ±2 db. **Inputs (2):** microphone and line. **Input impedance:** 1 megohm. **Model TR-1D & TR-1E outputs (2):** A and B stereo channels. **Model TR-1C output (1):** monophonic. **Output levels:** approximately 2 volts maximum. **Output impedance:** approximately 600 ohm (cathode followers). **Recording level indicator:** professional type db meter. **Bias erase frequency:** 60 kc. **Timing accuracy:** ±2%. **Power requirements:** 105-125 volts AC, 60 cycles, 35 watts. **Dimensions:** 15½" W. x 13¼" D. Total height 10¾". **Mounting:** requires minimum of 8½" below and 1½" above mounting surface. May be operated in either horizontal or vertical position.

MODEL TR-1C Monophonic Tape Deck: Monophonic Record and Playback. **$159.95** $16.00 DWN. $14.00 MO.

MODEL TR-1D Two Track Stereo Tape Deck: Monophonic Record and Playback, plus Playback of 2-track Pre-recorded Stereo Tapes (stacked). **$169.95** $17.00 DWN. $15.00 MO.

MODEL TR-1E Four Track Stereo Tape Deck: Monophonic Record and Playback, plus Playback of 4-track Pre-recorded Stereo Tapes (stacked). **$169.95** $17.00 DWN. $15.00 MO.

MODEL C-TR-1C Conversion Kit: Converts TR-1C to TR-1D (see TR-1D description above). Shpg. Wt. 2 lbs. **$19.95**

MODEL C-TR-1D Conversion Kit: Converts TR-1D to TR-1E (see TR-1E description above). Shpg. Wt. 2 lbs. **$14.95**

MODEL C-TR-1CQ Conversion Kit: Converts TR-1C to TR-1E (see TR-1E description above). Shpg. Wt. 2 lbs. **$19.95**

NOTE: To convert TR-1C to TR-1E, purchase both C-TR-1C and C-TR-1D conversion kits.

STEREO-MONO TAPE RECORDER KITS (TR-1A Series)

Here are the tape recorders the avid hi-fi fan will find most appealing! Their complete flexibility in installation and many functions make them our most versatile tape recorder kits. This outstanding tape recorder now can be purchased in any one of three versions. You can buy the new two-track (TR-1AH) or four-track (TR-1AQ) versions which record and play back both stereo and monophonic programming, or the two-track monophonic record-playback version (TR-1A) and later convert to either two-track or four-track stereo record-playback models by purchasing the MK-4 or MK-5 conversion kits. The tape deck mechanism is extremely simple to assemble. Long, faithful service is assured by precision bearings and close machining tolerances that hold flutter and wow to less than 0.35%. Power is provided by a four-pole, fan-cooled induction motor. One lever controls all tape handling functions of forward, fast-forward or rewind modes of operation. The deck handles up to 7" tape reels at 7.5 or 3.75 IPS as determined by belt position. The TR-1A series decks may be mounted in either a vertical or horizontal position (mounting brackets included). The TE-1 Tape Electronics kits supplied feature NARTB equalization, separate record and playback gain controls and a safety interlock. Provision is made for mike or line inputs and recording level is indicated on a 6E5 "magic eye" tube. Two circuit boards simplify assembly.

MODEL TR-1A: Monophonic two-track record/playback with fast forward and rewind functions. Includes one TE-4 Tape Electronics kit. Shpg. Wt. 24 lbs. **$99.95** $10.00 DWN. $9.00 MO.

TR 1A SPECIFICATIONS—Frequency response: 7.5 IPS ±3 db 50 to 12,000 cps; 3.75 IPS ±3 db 50 to 7,000 cps. **Signal-to-noise ratio:** better than 45 db below full output of 1.25 volts /channel. **Harmonic distortion:** less than 2% at full output. **Bias erase frequency:** 60 kc (push-pull oscillator).

MODEL TR-1AH: Two-track monophonic and stereo record/playback with fast forward and rewind functions. Two TE-4 Tape Electronics kits. Shpg. Wt. 36 lbs. **$149.95** $15.00 DWN. $13.00 MO.

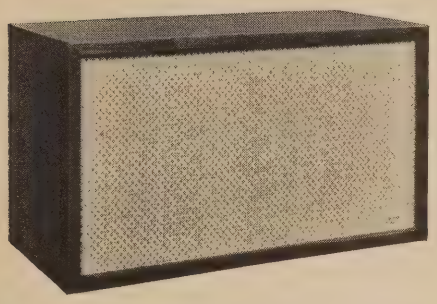
TR-1AH SPECIFICATIONS—Frequency response: 7.5 IPS ±3 db 40 to 15,000 cps; 3.75 IPS ± db 40 to 10,000 cps. **Signal-to-noise ratio:** 45 db below full output of 1 volt /channel. **Harmonic distortion:** less than 2% at full output. **Bias erase frequency:** 60 kc (push-pull oscillator).

MODEL TR-1AQ: Four-track monophonic and stereo record/playback with fast forward and rewind functions. Two TE-4 Tape Electronics kits. Shpg. Wt. 36 lbs. **$149.95** $15.00 DWN. $13.00 MO.

TR-1AQ SPECIFICATIONS—Frequency response: 7.5 IPS ±3 db 40 to 15,000 cps; 3.75 IPS ±3 db 40 to 10,000 cps. **Signal-to-noise ratio:** 40 db below full output of .75 volts / channel. **Harmonic distortion:** less than 2% at full output. **Bias erase:** 60 kc (push-pull oscillator).

HEATH COMPANY/Benton Harbor, Mich. a subsidiary of Daystrom, Inc.

New "Acoustic Suspension" Hi-Fi Speaker System Kit



HEATHKIT AS-2U (unfinished)

$69.95

HEATHKIT AS-2M (mahogany) **$79.95**
HEATHKIT AS-2B (birch) **EACH**

NOW—FOR THE FIRST TIME —EXCLUSIVELY FROM HEATH

ACOUSTIC SUSPENSION HI-FI SPEAKER SYSTEM KIT (AS-2)

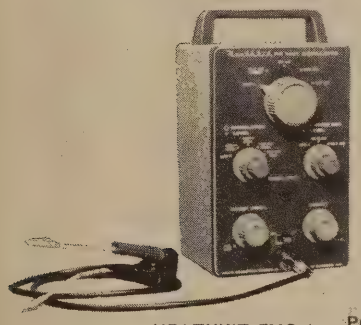
A revolutionary principle in speaker design, the Acoustic Research speaker has been universally accepted as one of the most praiseworthy speaker systems in the world of high fidelity sound reproduction. Heathkit is proud to be the sole kit licensee of this Acoustic Suspension principle from AR, Inc., and now offers for the first time this remarkable speaker system in money-saving, easy-to-build kit form.

The 10" Acoustic Suspension woofer delivers clean, clear extended-range bass response and outstanding high frequency distribution is provided by the specially designed "cross-fired" two-speaker tweeter assembly.

Another first in the Heathkit line is the availability of preassembled and prefinished cabinets. Cabinets are available in prefinished birch (blond) or mahogany, or in unfinished birch suitable for the finish of your choice. Kit assembly consists merely of mounting the speakers, wiring the simple cross-over network and filling the cabinet with the fiberglass included. Shpg. Wt. 32 lbs.

SPECIFICATIONS—Frequency response (at 10 watts input): ±5 db, 42 to 14,000 cps; 10 db down at 30 and 16,000 cps. **Harmonic distortion:** below 2% down to 50 cps, below 3% down to 40 cps at 10 watts input in corner room location. **Impedance:** 8 ohms. **Suggested amplifier power:** 20 watts minimum. **Suggested damping factor:** high (5:1 or greater). **Efficiency:** about 2%. **Distribution angle:** 90° in horizontal plane. **Dimensions:** 24" W. x 13¼" H. x 11¾" D.

New Test Equipment



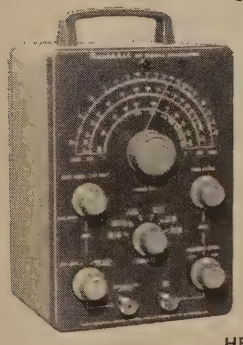
HEATHKIT FMO-1 Price to be announced

AN INSTRUMENT LONG-AWAITED BY SERVICE TECHNICIANS EVERYWHERE!

HEATHKIT FM TEST OSCILLATOR KIT (FMO-1)

Here in one compact, easy-to-use instrument are provided all the test signals and sweep frequencies required for fast, easy alignment and troubleshooting of RF, IF and detector sections of FM tuners and receivers. An instrument unique in the test equipment field . . . being the only one of its type designed especially for FM service work.

SPECIFICATIONS—Output frequencies: for RF alignment, 90 mc (FM band low end), 100 mc (FM band middle range), 107 mc (FM band high end). **Modulation:** 400-cycle incidental FM. **IF and detector alignment:** 10.7 mc sweep. **Sweep width markers:** 200 kc to over 1 mc, variable, 10.7 mc (crystal), 100 kc sub-markers. **Modulation:** 400-cycle AM. **For other applications:** 10.0 mc (crystal) and harmonics, 100 kc, 400-cycle audio. **Controls:** main frequency selector, modulation switch /concentric level control, marker oscillator switch /concentric level control, sweep width—power switch, output control, AF-RF (source impedance) switch. **Power supply:** transformer, selenium rectifier. **Power requirements:** 105-125 V, 50/60 cycles, 12 watts. **Cabinet size:** 7⅜" H. x 4¾" W. x 4¾" D.



HEATHKIT RF-1

$27.95

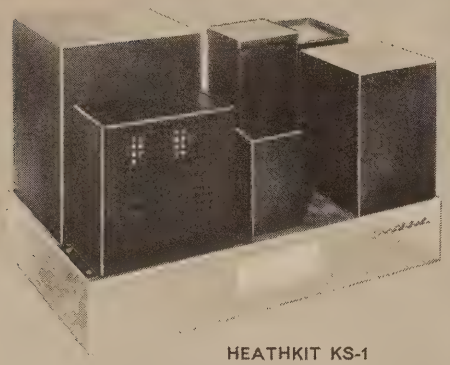
PREASSEMBLED AND ALIGNED BANDSWITCH/COIL ASSEMBLY

RF SIGNAL GENERATOR KIT (RF-1)

Moderately priced, and capable of precision performance the RF-1 provides highly accurate and stable RF signals for trouble-shooting and aligning RF and IF circuits of all kinds. Modulated or unmodulated RF output of at least 100,000 microvolts is available, controlled by both fixed-step and continuously variable controls. A built-in 400 cycle audio generator with 10-volt output provides internal modulation of RF signal and is available separately for audio tests. A preassembled bandswitch and coil assembly, aligned to factory precision standards, eliminates the need for special alignment equipment. Shpg. Wt. 7 lbs.

SPECIFICATIONS—Frequency range: Band A, 100 kc to 320 kc; Band B, 310 kc to 1.1 mc; Band C, 1 mc to 3.2 mc; Band D, 3.1 mc to 11 mc; Band E, 10 mc to 32 mc; Band F, 32 mc to 110 mc. **Calibrated harmonics:** 110 mc to 220 mc. **Accuracy:** 2%. **Output:** impedance, 50 ohms; voltage, in excess of 100,000 uv on all bands. **Modulation:** internal, 400 cycles approx. 30% depth; external, approx. 3 V across 50 k ohm for 30%. **400 cycles audio output:** approx. 10 V open circuit. **Tube complement:** V1 12AT7 RF oscillator, V2 6AN8 modulator and output. **Power requirements:** 105-125 V 50/60 cycles AC, 15 watts. **Aluminum cabinet dimensions:** 6¼" W. x 9½" H. x 5" D.

New HEATHKIT Ham Radio Gear



HEATHKIT KS-1

$169.95

TOP POWER WITH ECONOMY AND SAFETY

KILOWATT POWER SUPPLY KIT (KS-1)

The KS-1 is designed as a companion to the "Chippewa" Linear Amplifier and is also suitable for supplying plate power to most other RF amplifiers in the medium to high power class. The KS-1 features an oil-filled, hermetically sealed plate transformer to minimize corona, a swinging choke in the filter circuit for good regulation, and a 60-second time delay relay to permit adequate heating of the mercury vapor rectifiers before application of plate voltage. All components are conservatively rated and well insulated for long life and dependable service. Shpg. Wt. 105 lbs.

SPECIFICATIONS—Maximum DC power output: 1500 watts. **Nominal DC voltage output:** 3000 or 1500 volts. **Maximum DC current output:** Average 500 ma, peak 1000 ma. **Regulation:** 180 to 600 ma (typical linear amplifier), 8%; 0 to 300 ma (typical class C amplifier), 10%; 0 to 500 ma, 15%. **Ripple:** Less than 1%. **Tube complement:** (2) 866A mercury vapor rectifiers. **Recommended ambient temperature:** 50 to 100 degrees F. **Circuit:** Two half-wave mercury vapor rectifiers in a full wave, single-phase configuration with swinging choke input filtering. **Line power requirements:** 115 V, 50/60 cycles, 20 amperes; 230 V, 50/60 cycles, 10 amperes. **Chassis size:** 17¾" W. x 12" H. x 13" D.

HEATHKIT KL-1

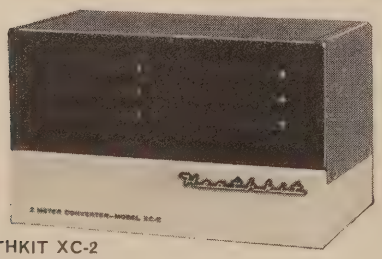
$415.00

MOVE TO THE TOP IN TRANSMITTING POWER

"CHIPPEWA" KILOWATT LINEAR AMPLIFIER KIT (KL-1)

The KL-1 operates at maximum legal amateur power inputs in SSB, CW or AM service using any of the popular CW, SSB and AM exciters as a driver. Premium tubes (4—400's) push the "Chippewa" to top performance levels while a centrifugal blower provides more than adequate cooling. Shpg. Wt. 70 lbs.

SPECIFICATIONS—RF section: Driving power required (10 meters); Class AB1 (tuned grid) 10 watts peak; Class C (tuned grid) 40 watts; Class AB1 (swamped grid) 60 watts peak. **Power input:** Class AB1 (SSB-voice modulation) 2000 watts PEP; Class AB1 (SSB-two tone test) 1300 watts; Class AB1 (AM linear) 1000 watts; Class C (CW) 1000 watts. **Power output (20 meters):** Class AB1 (SSB-voice modulation) 900 watts PEP; Class AB1 (SSB-two tone test) 550 watts; Class AB1 (AM linear) 300 watts; Class C (CW) 750 watts. **Output impedance:** 50 to 72 ohms (unbalanced). **Input impedance:** 50 to 72 ohms (unbalanced). **Band coverage:** 80, 40, 20, 15 and 10 meters. **Panel metering:** 0 to 50 ma, grid current; 0 to 100 ma screen current; 0 to 5000 volt plate voltage; 0 to 1000 ma plate current. **Tube complement:** Final tubes, (2) 4-400A; clamp tube, (1) 6DQ6; voltage regulators, (4) OD3, (2) OC3. **Power requirements:** AC (power supply primary circuit), 250 watts, 115 volt, 50/60 cycles; DC, 3000 to 4000 volts, 450 ma. **Cabinet size:** 19½" W. x 11⅝" H. x 16" D.



HEATHKIT XC-2

$36.95

2-METER CONVERTER KIT (XC-2)

Extends coverage of the Heathkit "Mohawk" Receiver to the 2-meter band. May also be used with receivers tuning a 4 mc segment between the frequencies of 22 and 35 mc when appropriate crystal is used. Shpg. Wt. 7 lbs.

SPECIFICATIONS—Noise figure: 4.5 db; 1 uv signal provides 20 db thermal noise quieting. **Sensitivity:** approx. .1 uv input will provide a signal better than 6 db over noise level. **Gain:** approx. 40 db. **Pass band:** essentially flat 144 to 148 mc; approx. 35 db down at 143 and 149 mc. **Image rejection:** better than 100 db (tunable). **Output impedance:** 50 to 75 ohms. **Input impedance:** 50 to 75 ohms; 300 ohms with balun. **Frequency:** input, 144 to 148 mc; output, 22 to 26 mc with crystal supplied. **Tubes:** 6AM4, 6BS8, 6EA8, 12AT7. **Crystal:** .005% 3rd overtone. **Power requirements:** 150 volts DC at 50 ma (dropping resistor supplied for 210 VDC RX-1 operation) 6.3 volts AC/DC at 1.375 amps. **Size:** 9" W. x 5½" H. x 4¾" D.

HEATHKIT UT-1

$28.95

"BEST BUY" UTILITY POWER SUPPLY KIT (UT-1)

This power supply is ideal for converting the Heathkit "Cheyenne" and "Comanche" mobile transmitter and receiver to fixed station operation; or may be used to provide necessary filament and plate voltage for a wide variety of amateur equipment. Features silicon diode rectifiers, high capacity filters for superior dynamic regulation, and line filtering to minimize TVI and reduce receiver line noise. On ICAS basis, provides 150 watts DC plus filament power for 6.3 volt or 12.6 volt filament applications (6.3 VAC., 8 amps. or 12.6 VAC., 4 amps.; 600 VCD., 250 ma or 600 VDC., 200 ma and 300 VDC., 100 ma). Less than 1% ripple; excellent regulation. Housed in attractive green and gray-green cabinet measuring 9" long, 4¾" wide, 6" high. Shpg. Wt. 15 lbs.

New Citizen's Band Transceiver

WIRED OR KIT FORM

HEATHKIT CB-1
$42.95
(kit model)

HEATHKIT W-CB-1
$60.95
(wired model)
$6.10 dwn., $6.00 mo.

Both models include transceiver, crystal, microphone and two special power cords.

- No Tests to Take—No Operator's License Required
- Any Citizen 18 or Older Can Have Own Station
- Hundreds of Business and Personal Uses

CITIZEN'S BAND TRANSCEIVER KIT (CB-1)

The Heathkit CB-1 Citizen's Band Transceiver is a compact radio transmitter and receiver combination designed to operate on the new 11-meter "Citizen's Band". No tests to take, no special knowledge or operator's license required . . . you need only fill out forms we supply, and mail them to FCC to apply for station license. Operates just like any short wave radio used by police and other communication services. Front panel switch selects both "transmit" and "receive". Two or more Heathkit Transceivers provide you with your own 2-way radiotelephone system for making necessary business and personal contacts with family, friends or associates. A Heathkit accessory power supply makes the CB-1 completely portable for use in cars, trucks, boats, etc., using 6 or 12 volt batteries. With appropriate accessory antenna, the CB-1 can be used for communicating between truck and office, home and automobile, boat and shore, farm-house and field . . . literally hundreds of useful applications. Comes complete with microphone, 2 power cords for mobile or fixed operation, station ID card, call letters, and crystal for one channel and FCC application form. Order power supply and antenna separately. Attractively styled in two-tone "mocha" and "beige". Shpg. Wt. 10 lbs.

SPECIFICATIONS—Receiver type: Superregenerative detector with stage. **Power input:** 5 watts maximum to plate of final RF amplifier (FCC requirement). **Transmitter frequency control:** Third overtone type quartz crystal operating within 0.005% of marked channel frequency between −20° and +140°F. **Modulation:** AM plate and screen modulation automatically limited to less than 100% (FCC requirement). **Power supply:** Internal 117 V, 50-60 cycles, AC (35 watts). For 6 V battery power, use Model VP-1-6 Vibrator Power Supply (6.5 amps); for 12 V battery power, use VP-1-12 (4 amps). **Total B+ requirements:** 260 volts at 60 ma; total heater requirements, 6.3 volts at 1.5 amps or 12.6 volts at 0.75 amps. **Power rectifier:** 2 silicon diodes in full wave voltage doubler circuit. **Microphone:** Combination hand-held and desk-type, ceramic element, plastic case with cord and connector. **RF output impedance:** 50 ohms. **Speaker size:** 3½" (round). **Undistorted audio power output:** Approximately 1 watt. **Line cords:** Two supplied, one for AC operation, one for battery operation. Power circuits automatically switched when appropriate line cord is plugged in. **Cabinet dimensions:** 8" H. x 6" D. x 9¼" W.

SPECIFY FREQUENCY CHOICE
(1st and 2nd choice)

CLASS D CITIZEN'S BAND FREQUENCIES

26.965 mc	27.035 mc	27.115 mc	27.185 mc
26.975 mc	27.055 mc	27.125 mc	27.205 mc
26.985 mc	27.065 mc	27.135 mc	27.215 mc
27.005 mc	27.075 mc	27.155 mc	27.225 mc
27.015 mc	27.085 mc	27.165 mc	*27.255 mc
27.025 mc	27.105 mc	27.175 mc	

*This channel shared with Class C Radio Control.

ANTENNAS

CBU-1 "UTILITY" ANTENNA.....$9.95
Good coverage, portable antenna for temporary mobile or fixed installations. 45½" base-loaded antenna, 12' connecting cable, mounting bracket and clip. 3 lbs.

CBM-1 "MOBILE" ANTENNA.....$19.95
Best coverage mobile installation. Easy to install spring base, ¼ wave, 9' whip; 15' connecting cable and necessary hardware. 7 lbs.

CBF-1 "FIXED LOCATION" ANTENNA...$19.95
Excellent coverage, ¼ wave "ground plane", 9' elements; 50' connecting cable and mounting bracket. 7 lbs.

WIRED AND KIT FORM POWER SUPPLIES FOR MOBILE USE

6 volt Vibrator Power Supply for use with 6 volt batteries.
KIT—Model VP-1-6. Shpg. Wt. 4 lbs.....$7.95
WIRED—Model WVP-1-6. Shpg. Wt. 4 lbs.....$11.95

12 volt Vibrator Power Supply for use with 12 volt batteries.
KIT—Model VP-1-12. Shpg. Wt. 4 lbs.....$7.95
WIRED—Model WVP-1-12. Shpg. Wt. 4 lbs.....$11.95

HEATHKIT

ORDER BLANK

NOTE: all prices and specifications subject to change without notice.
Enclosed find ( ) check ( ) money order. Please ship C.O.D. ( )

On Express orders do not include transportation charges—they will be collected by the express agency at time of delivery.

On Parcel Post Orders include postage for weight shown. All prices are NET F.O.B. Benton Harbor, Michigan, and apply to Continental U.S. and Possessions only. 20% Deposit required on all C.O.D. orders.

HEATH COMPANY BENTON HARBOR 20, MICH.

a subsidiary of Daystrom, Inc.

Name_____

Address_____

City & Zone_____ State_____
(PLEASE PRINT)

SHIP VIA
- ☐ Parcel Post
- ☐ Express
- ☐ Freight
- ☐ Best Way

QUANTITY	ITEM	MODEL NO.	PRICE
	☐ SEND FREE HEATHKIT CATALOG	POSTAGE	
		TOTAL	

HEATHKITS are also available at your Dealer see listing on next page

FIX THAT MULTIMETER

Save money and time by making do-it-yourself repairs on this vital test instrument

By EDWIN BOHR*

ARE you trying to service TV sets or electronic circuits with a multimeter that has one or more burned-out ranges? Well, come on and get it fixed.

The intelligent technician, with a fair understanding of meter circuits, malfunctions and symptoms, can make many routine meter repairs. This will save the time, transportation and insurance costs of sending the meter to a repair station.

Furthermore, imported and kit meters, while sometimes very accurate and excellent in design, have low initial costs that make repair-station charges prohibitive.

Over 50% of all range burnouts, in both vacuum-tube and ordinary multimeters, occur when the leads are placed across high or moderate voltages with the meter in a low-ohms position.

When this happens, a high voltage (say 117 volts ac) is applied across a resistance in the neighborhood of 10 ohms. The resistance may literally vaporize. Other times a segment of the resistor will burn out. Or, if the voltage appeared across the resistor for only a split second, the turns of resistance wire may overheat, shorting adjacent turns. This last effect is not very spectacular, but it usually makes the range inaccurate.

Burned-out milliamp ranges, meter movements, voltage ranges, meter rectifiers and defective switches all account about equally for the remaining meter troubles.

At one time, bad milliamp ranges were rare. However, with TV techs measuring cathode current of horizontal output tubes, burned-out milliamp range resistors and switch contacts (from high-frequency arcs) are increasingly frequent.

No doubt there will be a slight recession of this particular damage as more technicians experience a burned-out milliamp section.

Defective resistors

Defective resistors in the various ranges account for most troubles. And the resistors damaged are usually less than 1,000 ohms in resistance. In other words, look for trouble in the low-resistance precision resistors. The high values hardly ever burn out.

The reason is simple—high values of resistance require a very high impressed voltage to exceed their wattage rating, while a low-resistance precision resistor may take a beating with an overload of less than 25 volts.

Burned-out wirewound resistors are usually easy to spot. Look for smoke, overheated wrapping or wire. If the resistors are nested in cavities, there is sometimes a smoke smudge on the inside of the case, adjacent to the cavity.

With a strong beam of light shining at the best angle, it is also possible to look into the cavity and see the damaged resistor.

Defective deposited-film resistors are hard to spot. Usually a small blister or darkening of the varnish is the only visible indication. And this is not always evident. Bad units with protective sleeves defy visual detection even more completely.

When the defective resistor (or resistors) is located, temporarily substitute the nearest value 10% unit and check the meter for proper function. You can even use the meter this way, at reduced accuracy, until you can get an exact replacement.

To order the resistor, carefully refer to the operating manual for the exact repair-part number. You can expect some help from your parts distributor in this regard. But, after all, it is your meter and you should know exactly which resistor you need before placing the order.

Ohmmeter circuits and defects

If the trouble is not obvious, you must know enough about the circuit to find it from the symptoms.

Instruction-manual circuit diagrams are one stumbling block. They are usually too small, jumbled together and almost useless to anyone but the experienced instrument-service technician who often has the circuit committed to memory anyway.

However, the practical examples and simplified circuits that follow should help. Since resistance-range burnout is most common, let's start with the ohmmeter circuits.

Fig. 1 essentially shows the very popular Simpson 260 ohmmeter circuit lifted from the complete schematic. Fig. 2 is a simplified Triplett 630. Fig. 3 is the typical ohmmeter circuit found in vacuum-tube voltmeters.

Understand these three circuits and you have a key to tracing nearly any ohmmeter symptom to its source. The circuits are fundamental and apply, with slight variations, to all but a few instruments.

Look at Fig. 1 with a selector switch in the $\times 1$ position. When the probes are open there is no voltage across the 11.5-ohm resistor and the meter stays at its mechanical zero, indicating infinite resistance.

Now, if the probes are shorted, the full 1.5 volts appear across the 11.5-ohm resistor—except for a small voltage

*Electronic Instrument Service, Chattanooga, Tenn.

drop across the dry-cell internal resistance and wiring resistances.

Next, the ZERO ADJ knob is moved until full-scale current flows through the meter, corresponding to zero ohms.

Notice the meter is measuring the voltage across the 11.5-ohm resistor, but the scale is calibrated in ohms. If we place a 12-ohm resistor between the probes, the voltage across the 11.5-ohm resistor will be cut half and the meter will read half-scale.

This simple concept helps to analyze ohmmeter troubles mentally and to establish their cause and location.

Suppose you have a Simpson 260 (similar to Fig. 1) and the pointer always goes to zero ohms on all ohms scales, unless very high resistances are placed between the probes. In other words, the scales indicate several thousand percent low.

This clearly indicates the 11.5-ohm resistor is open, making center scale not 12 ohms, but thousands of ohms. It also disables the other ohms ranges.

Temporarily replace the burned-out 11.5-ohm resistor with a 10-ohm composition unit. This restores the ×1 range. It now indicates several ohms off at center scale, but the remaining ohms ranges operate at full accuracy.

Resistors do not always burn out. In Fig. 1, if the ×10,000 and ×100 ranges are OK, but the ×1 range *indicates* resistance much *higher* than the

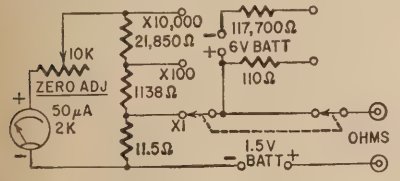


Fig. 1—In this type of ohmmeter circuit the 11.5- and 1,138-ohm resistor are most often damaged.

actual values, you can be sure the 11.5-ohm resistor is partially shorted.

Occasionally, two resistors are damaged. If it is impossible to zero the meter on its ×1 scale and the meter indicates ridiculously low on the ×100 scale, experience shows that both the 11.5- and 1,138-ohm resistors are usually defective. However, a few cases with these symptoms occur with only the 1,138-ohm resistor damaged.

It is unlikely that any of the other resistors will burn out or be damaged by overload. You may question this statement as applied to the 110-ohm resistor. However, it receives only one-tenth the 1,138-ohm resistor overload which will blow first, like a fuse.

Fig. 2 is a slightly different circuit. The ZERO ADJ shunts the meter and each ohms scale has an independent set of range resistors. Burnout of one resistor will not affect the other ranges.

The most-likely-to-burn-out resistors are the 4-, 40- and 5,000-ohm units. Occasionally, we find the 16,000-ohm resistor will change value, making it impossible to set zero by either too much or too little current.

The astute reader may notice the

Here's where to buy your HEATHKIT locally . . .

CALIFORNIA
BERKELEY
zacKIT Corporation
CHICO
Dunlap Radio & TV
EL CAJON
Telrad Electronics
FRESNO
Dunlap Radio & TV
LOS ANGELES
Kierulff Sound Corporation
(2 Locations)
MARYSVILLE
Dunlap Radio & TV
MERCED
Dunlap Radio & TV
MODESTO
Dunlap Radio & TV
PALO ALTO
Zack Electronics
RIVERSIDE
Kierulff Sound Corporation
SACRAMENTO
Dunlap Radio & TV
SAN DIEGO
Telrad Electronics
SAN FRANCISCO
Zack Electronics
SANTA BARBARA
zacKIT Corporation
STOCKTON
Dunlap Radio & TV
TARZANA
Kierulff Sound Corporation
VISALIA
Dunlap Radio & TV

DELAWARE
WILMINGTON
Radio Electric Service Co.

FLORIDA
COCOA
Thurow Distributors, Inc.
DAYTONA BEACH
Thurow Distributors, Inc.
JACKSONVILLE
Thurow Distributors, Inc.
MIAMI
Thurow Distributors, Inc.
ORLANDO
Thurow Distributors, Inc.
PENSACOLA
Thurow Distributors, Inc.
ST. PETERSBURG
Thurow Distributors, Inc.
TALLAHASSEE
Thurow Distributors, Inc.
TAMPA
Thurow Distributors, Inc.

ILLINOIS
ALTON
Radonics—Alton, Inc.

INDIANA
FORT WAYNE
Ft. Wayne Electronics Supply, Inc.
INDIANAPOLIS
Graham Electronics Supply, Inc.
LAFAYETTE
Lafayette Radio Supply Co., Inc.
MUNCIE
Muncie Electronics Supply, Inc.

IOWA
DES MOINES
Radio Trade Supply Co.
FORT DODGE
Radio Trade Supply Co.
MARSHALLTOWN
Radio Trade Supply Co.
WATERLOO
Radio Trade Supply Co.

LOUISIANA
LAFAYETTE
Sterling Electronics, Inc.

MARYLAND
BALTIMORE
American Distributing Co.
(2 Locations)
The HI-FI Shop
SALISBURY
Radio Electric Service Co.

MASSACHUSETTS
BOSTON
Audionics, Incorporated

MICHIGAN
ALLEN PARK
Volta Electronics
DETROIT
High Fidelity Workshop
PONTIAC
High Fidelity Workshop

MINNESOTA
DULUTH
Lew Bonn Company
LA CROSSE
Lew Bonn Company
MINNEAPOLIS
HI-FI Sound
Lew Bonn Company
ST. PAUL
HI-FI Sound
Lew Bonn Company

MISSOURI
ST. LOUIS
Radonics
(2 Locations)
Radonics-West, Inc.
Radonics-Gravois, Inc.

NEW JERSEY
ATLANTIC CITY
Radio Electric Service Co.
CAMDEN
Radio Electric Service Co.
MOUNTAINSIDE
Federated Purchaser, Inc.
NEWARK
Federated Purchaser, Inc.

NEW YORK
ALBANY
Fort Orange Radio Dist. Co., Inc.
BATH
Rochester Radio Supply Co., Inc.
BELLEROSE
Cross Island Electronics, Inc.
BINGHAMTON
Stack Electronics, Inc.
BROOKLYN
Acme Electronics, Incorporated
ELMIRA
Stack Electronics, Inc.
FARMINGDALE
Gem Elec. Distributors, Inc.
FOREST HILLS
Beam Electronics, Incorporated
GENEVA
Rochester Radio Supply Co., Inc.
HERKIMER
Herkimer Electronics Co., Inc.
HICKSVILLE
Gem Elec. Distributors, Inc.
MINEOLA
Arrow Electronics, Incorporated
MT. VERNON
Davis Radio Distributing Co., Inc.
NEW YORK
Arrow Electronics, Incorporated
Harvey Radio Company
ROCHESTER
Rochester Radio Supply Co., Inc.
SYRACUSE
Syracuse Radio Supply Co., Inc.
UTICA
Genesee Electronics Company
VALLEY STREAM
Elm Electronics, Inc.
WATERTOWN
Watertown Electronics Company

NO. CAROLINA
CHARLOTTE
Southeastern Radio Supply Co.
FAYETTEVILLE
Southeastern Radio Supply Co.
GREENSBORO
Southeastern Radio Supply Co.
KINSTON
Southeastern Radio Supply Co.
RALEIGH
Southeastern Radio Supply Co.

OHIO
AKRON
Sun Radio Company
CHILLICOTHE
Buckeye Electronics Dist., Inc.
CLEVELAND
Pioneer Electronic Supply Co.
(2 Locations)
COLUMBUS
Buckeye Electronics Dist., Inc.
DAYTON
Ham 'n Hi-Fi, Inc.
LORAIN
Pioneer Electronic Supply Co.
MAPLE HEIGHTS
Pioneer Electronic Supply Co.
NEWARK
Buckeye Electronics Dist., Inc.
SANDUSKY
Pioneer Electronic Supply Co.
SPRINGFIELD
Standard Radio-Springfield, Inc.
TOLEDO
Lifetime Electronics
ZANESVILLE
Buckeye Electronics Dist., Inc.

OREGON
PORTLAND
Eccles Electric Company
SALEM
Cecil Farnes Company

PENNSYLVANIA
ALLENTOWN
Federated Purchaser, Inc.
EASTON
Federated Purchaser, Inc.
ERIE
J. V. Duncombe Co.
(2 Locations)
PHILADELPHIA
Austin Electronics, Inc.
Radio Electric Service Co.
(3 Locations)
PITTSBURGH
House of Audio
WILLOW GROVE
Radio Electric Service Co.
YORK
Radio Electric Service Co.

RHODE ISLAND
PROVIDENCE
Audionics, Incorporated

TEXAS
BEAUMONT
Sterling Radio Products, Inc.
BRYAN
Sterling Radio Products, Inc.
DALLAS
Hillcrest Records & HI-FI
HOUSTON
Sound Equipment, Incorporated
Sterling Radio Products, Inc.
LUFKIN
Sterling Radio Products, Inc.

VIRGINIA
ARLINGTON
Key Electronics, Inc.
NEWPORT NEWS
Cain Electronics Company, Inc.
NORFOLK
Cain Electronics Company, Inc.
(2 Locations)
PORTSMOUTH
Cain Electronics Company, Inc.
RICHMOND
Meridian Electronics, Inc.

WASHINGTON
SEATTLE
Seattle Radio Supply, Inc.

WISCONSIN
MADISON
Hi-Fi Corner
Satterfield Electronics, Inc.
MILWAUKEE
Hi-Fi Center
Netzow's

Careful selection of reliable qualified dealers is a slow process . . . so please bear with us if your area has not been covered. Thank you.

New York Service Representative
Empire State Electronic Serv., Inc.
180-14 Union Turnpike
Flushing 66, Long Island, New York

HEATHKIT
HEATH COMPANY/Benton Harbor, Mich.
a subsidiary of Daystrom, Inc.

THE FISHER

Laboratory Matched Tubes

At FISHER RADIO, the age of mass production is still on the 'outside looking in.' FISHER Laboratory Tested and Matched Tubes are still individually selected, and *guaranteed* to fulfill the maximum requirements of your high fidelity components.

For absolutely minimum hum, noise and distortion – choose FISHER Tubes. For high fidelity performance free of disturbing microphonics and intermittents – choose FISHER Tubes. For perfectly matched power output tubes designed specifically for stereo reproduction – choose FISHER Tubes. You will find no 'variables'– nothing less than the best in every box.

Audio-Fans, Servicemen, Dealers

WRITE TODAY FOR COMPLETE INFORMATION

FISHER RADIO CORPORATION, 21-40 44th Drive, L. I. C. 1, N. Y.

I want to know more about FISHER Laboratory Matched TUBES!

NAME _____

STORE NAME _____
(If a serviceman or dealer)

ADDRESS _____ CITY _____ STATE _____

change in mode of operation for both circuits (Fig. 1 and 2) on the highest range. Here the meter reads current through, rather than voltage across, the range resistors.

Fig. 3 is the common vtvm type of ohms-measuring circuit. The values listed are the same as the RCA Volt-Ohmyst Senior.

With no resistance connected to the probes, V1 directly measures the dry-cell voltage (V1's output drives a meter), since there is no voltage drop across any of the range resistors.

Center-scale marking for the RCA meter is 10 ohms. On its lowest range, the battery and wiring resistance account for about 0.25 ohm, making the lowest-range resistor 9.75 ohms. Connect a 10-ohm resistor to the probes and V1 receives only half the battery

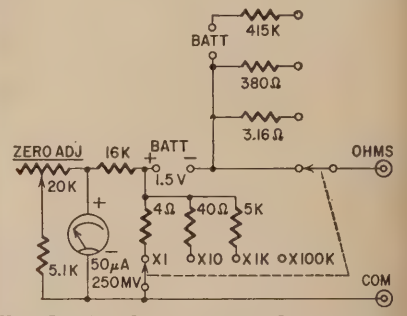


Fig. 2—Another common ohmmeter circuit. The 4- and 40-ohm resistors are usually the first ones to be damaged by overload.

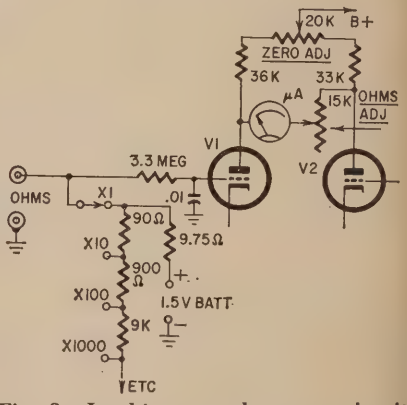


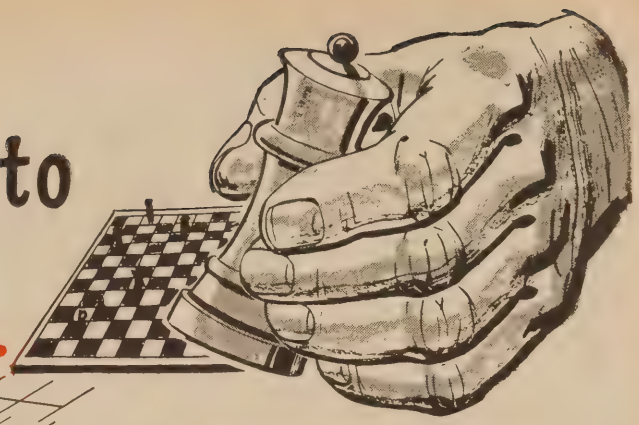
Fig. 3—In this vtvm ohmmeter circuit the 9.75-ohm resistor is normally the only one that burns out.

voltage, indicating 10 ohms at half-scale.

Usually, only the 9.75-ohm resistor burns out. With it open, the other resistors are removed from any current path. However, if the 9.75-ohm resistor opens, all ranges become inoperative. This happens because there is no longer a return to the dry cell, and V1's grid floats, except when the probes are shorted.

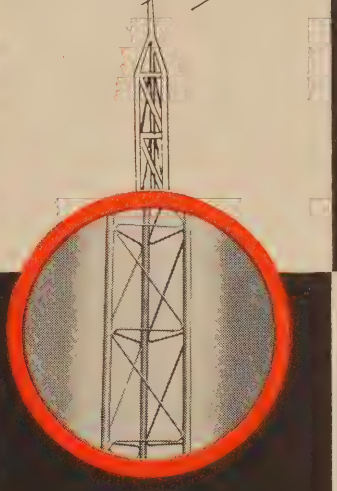
With probes apart, the pointer lazily drifts about or goes to either end of the scale. Connect any resistance to the probes and the pointer goes to the zero-set position.

make your first move to ROHN



You Have the Greatest Sales Potential by Far With America's MOST COMPLETE LINE OF

TOWERS—MASTS
ROOF TOWERS
Installation Accessories



From every standpoint, ROHN Towers offer you MORE . . . more quality, more variety, more advanced design, more sales features, more service, more total sales and more PROFITS! Move forward with these ROHN items!

ROHN TV TOWERS

ROHN makes the finest towers available for television reception! Illustrated is the No. 25 with amazing "zig-zag" cross bracing design. The entire tower is rated 33% stronger than other similar sized towers. Yes, sell and install the No. 25 up to 50 feet self-supporting or, properly guyed, up to 360 feet!

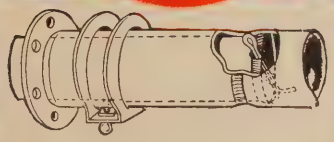
Or if you prefer, sell the popular ROHN No. 6 tower with the famous "Magic Triangle" cross-bracing. Both are fully HOT DIPPED GALVANIZED AFTER FABRICATION! Sections in easy-to-handle 10 ft. lengths.

ROHN COMMUNICATION TOWERS

Here you have FIVE complete lines of heavy-duty, FULLY ENGINEERED communication towers to fulfill any communications requirement. Shown is the ROHN "SS" tower which is self-supporting up to 130 feet. Other models — (30-40-50-60) are available in heights up to 630 feet when guyed! Handle these towers for the demand in your area. There's a complete NEW catalog on this line. Get a copy so you'll have it on hand.

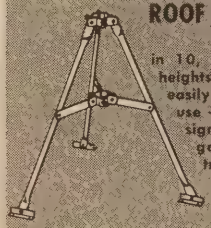
AMATEUR "FOLD-OVER" TOWERS

Specially designed "fold-over" towers are the best ever designed for amateur radio and experimentation. They are the most desired because they "fold-over" completely so you work on the ground for ease and safety. Three sizes, including heavy-duty type to handle any needs. All hot dipped galvanized.



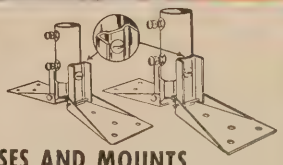
TELESCOPING MASTS

Unexcelled in design, structural strength, and sales appeal. All popular sizes, heights, and weights available. Also, mast tubing in exact specifications that's demanded today.



ROOF TOWERS . . .

in 10, 5, 3, and 2½ feet heights — very popular — easily shipped — ideal in use — the best ever designed — in hot-dipped galvanized finish — truly a big profit item for you!



BASES AND MOUNTS

Wide variety of bases and mounts. Special features include "locking" device—also cast aluminum roof mounts—and a host of other installation items . . . get full details.

TV SERVICE TABLE

For holding TV sets while servicing, or storing, or for mobile use of set in such places as motels, hospitals, etc. Ideal for dozens of uses —thousands sold. Large casters—a real work-saver.

ROHN

Manufacturing Company

116 Limestone, Bellevue
Peoria, Illinois

Get complete catalog from your ROHN representative or jobber or MAIL THIS COUPON!

Gentlemen: Please send me literature on ROHN Towers and Accessories.

Firm _____

Name _____ Title _____

Address _____

City _____ State _____

this

is a picture of the technician who had a call-back on a Quam Speaker installation.

(You'll notice the space is blank. Servicemen who install Quam speakers can "sell 'em and forget 'em." You just don't get called back.)

this

is a picture of a Quam speaker which was defective when received from the factory.

(This space is blank, too. Every Quam speaker is individually checked and tested before it leaves the factory.)

this

is a picture of your bank book.

You'll notice how your deposits grow when you rely on Quam Adjust-a-Cone Speakers for every installation.

QUAM-NICHOLS COMPANY

234 E. MARQUETTE ROAD • CHICAGO 37, ILLINOIS

ALWAYS INSIST ON PROVED BRAND NAMES

Ask By Name For GENUINE "NO NOISE" PRODUCTS

BEWARE OF CHEAP SUBSTITUTES

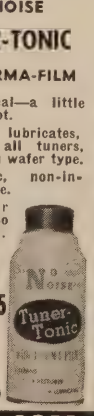
NO-NOISE TUNER-TONIC

With PERMA-FILM

- Economical—a little does a lot.
- Cleans, lubricates, restores all tuners, including wafer type.
- Non-toxic, non-inflammable.
- Use for TV, radio and FM.

6 Oz. Aerosol Can

$3.25 NET to Servicemen



NO-NOISE VOLUME CONTROL and CONTACT RESTORER

• Cleans • Protects • Lubricates

NOT A CARBON TET SOLUTION

2 Oz. Bottle $1.00 NET to Servicemen

6 Oz. Spray Can $2.25 NET to Servicemen

NOW AVAILABLE

FREE AT YOUR JOBBERS

5" PLASTIC EXTENDER

With Push Button Assembly For Pin-Point Applications Does Not Cause Shorts

ELECTRONIC CHEMICAL CORP. 813 Communipaw Avenue Jersey City 4, N. J.

TEST INSTRUMENTS

It is interesting to note the meter is usually not damaged, except for a bent pointer, in any of the preceding cases. The resistors take the beatings.

Milliamp circuits

When multimeters are left in the mills position and touched across voltage, a resistor is sure to blow. If the voltage is above about 10, the meter movement will also be damaged.

Fig. 4 (Simpson 260, essentially) and Fig. 5 (Triplett, essentially) are representative circuits. Both circuit

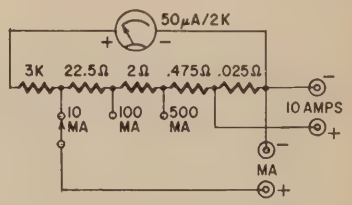


Fig. 4—If the milliampere ranges do not work and the circuit looks like this one, check the 0.475- and 2-ohm resistors first.

techniques keep switch-contact resistance from causing what would otherwise be enormous errors in these low-resistance circuits.

The Simpson circuit keeps the current-carrying-contact resistance in series with the shunt and meter circuit. Thus, it never appears between shunt and meter.

Notice if any single resistor fails all the milliamp ranges are knocked out. The 2- and 0.475-ohm resistors are most often damaged.

Fig. 5 is a special circuit that discriminates against switch resistance with a double-contact arrangement and independent shunts.

Because of the low and rather uncommon resistance of milliamp shunts, you must usually depend entirely upon factory replacement parts. Sometimes, in large electronics centers, you may find an electronics lab with the necessary special-alloy wire and measuring equipment that will wind a replacement resistor on the old bobbin.

Ac-range damage

Fig. 6 is a typical ac volts circuit. Two ac range components, R_M and the rectifier composed of D1 and D2, account for about 90% of all ac voltmeter

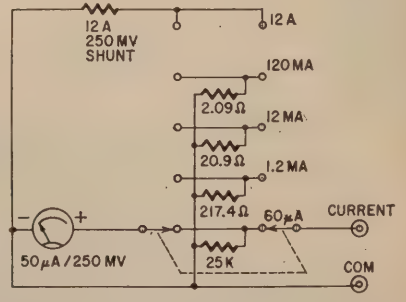


Fig. 5—Special circuit used to prevent contact resistance errors. The 2.09-, 20.9-, and 217.4-ohm resistors are frequently damaged.

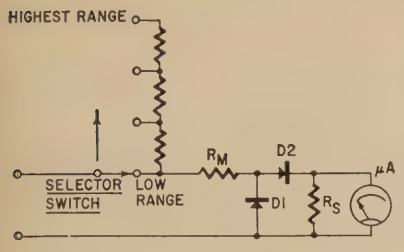


Fig. 6—Typical ac volts circuit.

defects. Invariably, a damaged R_M means the rectifier is also damaged.

R_M is the multiplier for the lowest range only, and its value must usually be chosen to provide correct calibration for each individual rectifier assembly on the lowest range. Resistor R_S adjusts the sensitivity for all ranges.

Check the diodes by disconnecting them from the meter and calibrating resistors. Next, measure each one with an ohmmeter, swapping the probes each time. If the diode is undamaged, a large difference in resistance reading should be noticed when the probes are swapped (about 10 to 1).

If the rectifier is bad, you can usually order a factory-calibrated assembly, complete with rectifier and matched values of R_S and R_M. Or, you can use the listed Conant replacement rectifier, or two germanium diodes—1N34-A's, for example.

In the last instance, check the meter for accuracy near full scale on the highest practical range. Usually, the instrument will be within tolerance. If not, change the value of R_S until a correct indication is given. Now, switch to the lowest range and adjust the value of R_M for correct calibration.

A note of caution: After soldering the diodes in place, be sure they have cooled completely before calibrating the instrument. This cooling takes several minutes.

Dc-voltage ranges

The dc voltmeter circuit is very simple. Proper resistors are simply switched in series with the meter movement to make it read full scale on a specific voltage. These resistors normally do not overheat, even with extreme high-voltage overloads. Consequently, they are a rare source of trouble.

However, electronics people are always interested in checking the accuracy of the dc ranges. Mallory mercury cells, available at electronics parts distributors, make excellent calibration standards. Each cell has a potential of 1.345 volts that changes very little with temperature, age or loading of the usual multimeter. Accuracy of these cells can be considered better than ±0.25%.

Three cells in series provide a standard voltage of 4 volts within 1%; six cells, 8 volts, and five 8-volt mercury batteries in series supply 40 volts, etc.

Inaccuracy, other than mechanical difficulties in the meter movement, is usually caused by a drop in field strength of the magnet or partial shorts in the armature. Both defects affect the milliamp, ac and dc volt calibrations equally. This establishes a good cross-check to see if the trouble is definitely in the meter-movement sensitivity.

As long as there is enough sensitivity to zero the ohms ranges, decreases in meter sensitivity do not affect ohms-scale accuracy.

Meter movement

The two causes of meter inaccuracy mentioned above must be handled by a repair station. This is true, also, of magnetic trash in the meter, badly bent pointers, poor balance, bad pivots and bearings.

If the meter-panel glass breaks or even if it gets loose, immediately seal the meter in a clean box or bag until the glass is resealed or replaced. Otherwise, microscopic particles will be pulled into the powerful magnetic meter gap with its minuscule clearance from the moving armature. This can cause the armature to hang and result in a trip to the repair station.

A local glass store can cut a replacement meter glass. Completely remove the original sealing compound and reseal the new glass with a layer of corona dope brushed around the edge of the new glass.

Switches

Contacts burn out or lose their spring pressure from overheating. This, again, requires a major repair that few technicians are equipped to handle. However, carbonization of the switch wafer is a difficulty often repaired with little trouble.

Carbonization results from a high-voltage arc between contacts. This burns the switch wafer, changing the surface to carbon.

The arc actually forms a carbon resistor between contacts. Continued use under high-voltage conditions may produce a continuous arc and completely burn through the switch.

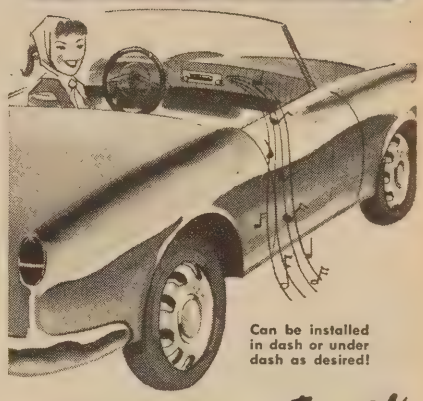
Carbonization frequently makes vtvm's behave erratically. If everything else appears OK, check all the switch surfaces closely with sharp eyes and a good strong light.

To repair the carbonized section, completely but carefully dig and scrape away the carbonized material with a pointed knife blade. Then fill the area with one or two small drops of corona dope or Krylon.

In high-humidity areas a thin coat of silicone grease over the switch wafer and rotor is good insurance against future arcs.

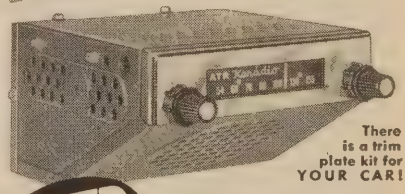
Multimeter repair requires diverse and specialized experience, parts and equipment—to say the least. Many jobs simply must be handled by the specialist. However, if a multimeter user follows the preceding suggestions, he can often have his meter back in service in a couple of hours. END

Introducing ATR CUSTOMIZED Karadio



Can be installed in dash or under dash as desired!

for small import cars and compact U.S. cars

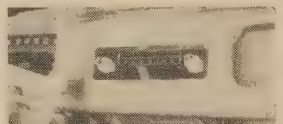


There is a trim plate kit for YOUR CAR!

ATR CUSTOMIZED Karadio

• VIBRATOR-OPERATED with Tone Control

The ATR Customized Karadio is a compact, new, self-contained airplane-styled radio for small import and compact American cars. This economical unit is perfect for all small cars because it can be easily and inexpensively installed in-dash or under-dash on most any make or model automobile—and its powerful 8-tube performance provides remarkable freedom from engine, static, and road noises. ATR Karadios are built to look and fit like original equipment with sleek, modern styling and solid, single-unit construction. They offer many customized features and provide highest quality fidelity—yet cost far less than comparably designed units. The ATR Customized Karadio comes complete with speaker and ready to install . . . and is the ideal way to add fun and value to your small import or American automobile!



ATR KARADIO . . . is ideal for small import cars or compact American cars! Unit is completely self-contained—extremely compact! Can be mounted in-dash or under-dash—wherever space permits! For 6 volt or 12 volt!

SEE YOUR JOBBER OR WRITE FACTORY

• "A" Battery Eliminators • DC-AC Inverters • Auto Radio Vibrators

ATR AMERICAN TELEVISION & RADIO CO.
Quality Products Since 1931
SAINT PAUL 1, MINNESOTA, U. S. A.

Put your money on

THE LINE

LOW RESONANCE—ULTRA COMPACT

In the popular ultra-compact low resonance systems only Electro-Voice markets a full line. Only Electro-Voice *Royal 400* offers a 3-way mated system —with *18" woofer* for *Patrician* quality bass response. Only Electro-Voice *Leyton* outperforms similar two-way systems — at 25 handsome dollars less money to your customers. If you put your money on this line, you'll be front-row-center for the grand opening of the wallet.

**All systems are illustrated with E-V's new Stereons for true 3-channel stereo. Esquire, Regal and Royal use Stereon 300 at $49.50 each. Leyton matches Stereon 100 at $34.50 each.*

Write Department 10E for your copy of our new Catalog No. 135 on High Fidelity Speakers and Systems.

Electro-Voice® INC., BUCHANAN, MICHIGAN

Esquire
200

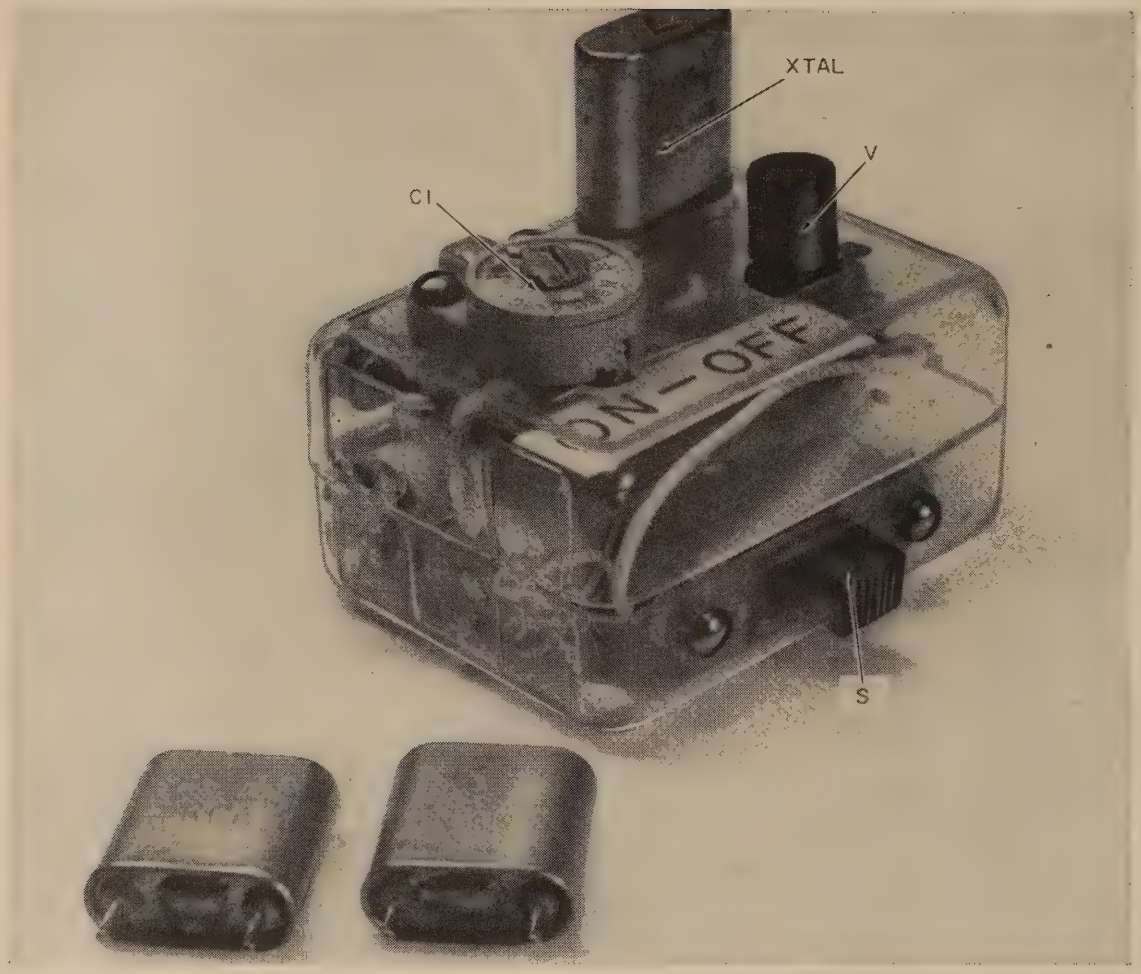
3-way economy system
12″ woofer
8″ midrange
compression HF tweeter
from $111.00
audiophile net*

Regal
300

3-way heavy duty system using 5 lb. ceramic magnet
12″ woofer
8″ midrange
compression HF tweeter
$165.00
audiophile net*

Leyton

2-way economy low resonance system
12″ woofer
8″ midrange
from $93.00
audiophile net*



Slide switch turns the compact oscillator on and off.

MULTIPURPOSE TRANSISTOR CRYSTAL OSCILLATOR

1-transistor unit serves as signal source for TV troubleshooting, crystal-controlled oscillator for dual-conversion receiver or band-spotting with communications receiver

By F. T. MERKLER

THIS crystal-controlled oscillator illustrates the old saying "Good things come in small packages." Here is just such a good thing. Plug in any fundamental crystal in the frequency range of 1.5 to 14 mc and get good sine-wave output, without tuning adjustments of any kind. The parts required are standard, few and inexpensive. An added bonus is the tiny amount of power drawn from the battery supply. In the first model built, battery life equaled shelf life.

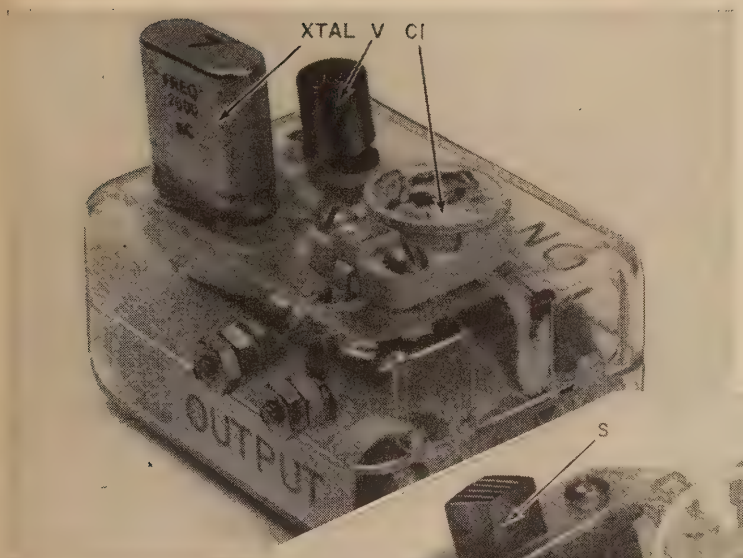
The photos give a general overall view of the oscillator, but this layout does not have to be followed. Any neat and reasonable mechanical layout of parts will work electrically. As the 2N247 is by far the most expensive component in the oscillator, I used a socket for mounting it. All wiring and visual checking is done before inserting the transistor in its socket. In this way the chances of damaging it because of excessive soldering heat or improper circuit connections are reduced. After the socket is mounted, color-code the collector connection end (a drop of nail polish is fine). The socket has five pin connections in a line; the 2N247 uses four of them. Note the gap between collector and shield. Plug the empty hole in the socket with a touch of service cement. It keeps you from inserting the transistor into its socket incorrectly.

The crystal socket is probably the next component to mount. The one to use depends on the crystal case size and pin spacing. Photos of my model show a Bliley type BH6 crystal. Pin spacing for this type is 0.500 inch. A matching socket is the National type CS-5.

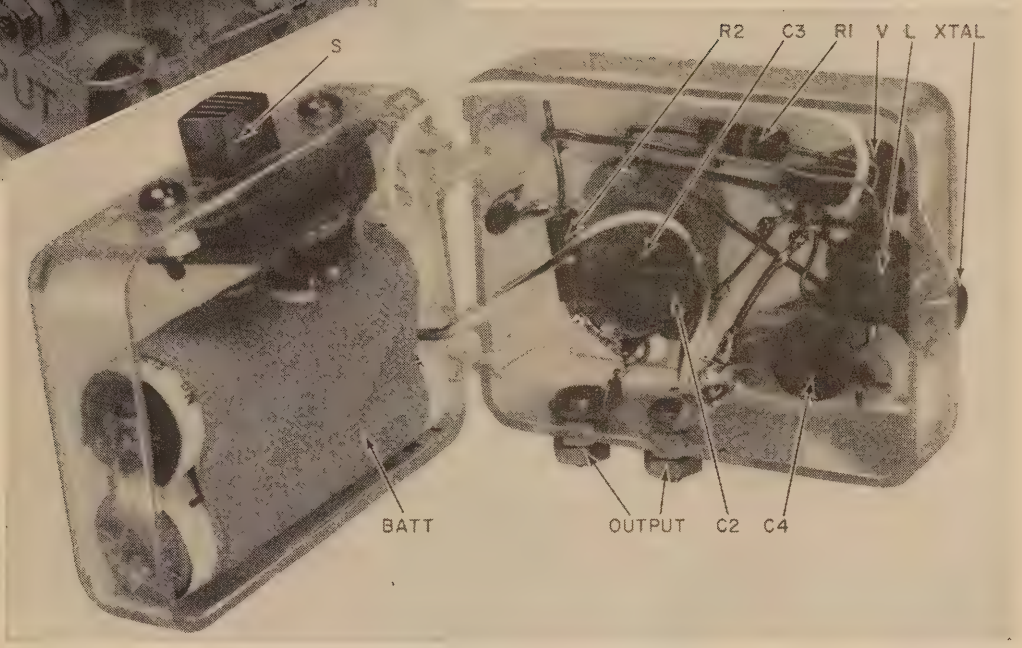
Place the ceramic trimmer adjacent and at right angles to the transistor and crystal sockets. Drill two small holes (No. 26 drill) through the plastic case and mount 4-40 screws in them to serve as the output terminals. The remaining small electrical parts are now soldered point-to-point following the schematic.

Final touch-up hints

Electrically, the schematic tells the whole story, except for miniature choke L. The circuit will oscillate without it, but output tends to drop with increas-



Output terminals are located on the rear of the case.



Compact layout makes the oscillator's small size possible.

ing frequency. The choke counteracts the drop in drive current to the transistor's base as the operating frequency goes up, by building up the impedance level of the emitter circuit. If in your application high-frequency operation is important, two things can be done to insure good results:

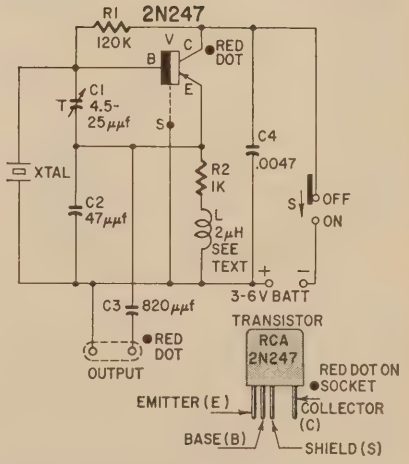
- Insert a 2-μh inductance, shown on the schematic as L.
- Increase the supply voltage to 4.5 or higher.

The second step is particularly important to the efficient use of drift type transistors. RCA application notes show a pronounced knee in the curve that relates collector volts to cutoff frequency.* Practically, if we have a collector supply voltage of 4 volts or more, the collector-voltage field extends through the impurity region near the base and the transistor gives the maximum gain of which it is capable. In neutralized amplifier circuits, the 2N247 transistor gives some gain until frequency gets beyond 50 megacycles. So any fundamental crystal (they range up to about 14 mc) will work in this circuit.

Now that you've built this small convenient oscillator, I'm sure you will find many uses for it. For example, as a signal source for TV troubleshooting, or for the crystal-controlled oscillator feeding the second mixer in a dual-conversion high-frequency receiver. The oscillator can be used as a known frequency feeding one set of plates on your scope, while an unknown frequency is fed to the other set of plates. Use it for band spotting with your high-frequency receiver. Many times, all you have to do to get a signal into a circuit under test is to place a wire clip lead on the oscillator's hot output terminal, and let this wire rest on the bench close by the trouble spot.

Adjust trimmer capacitor C1 with the aid of a scope at the highest frequency you expect to use. Set it for the cleanest-possible highest-amplitude waveform, and you're done. This will be close to a mid-range setting of the capacitor with a normal variety of crystal. END

*A. Kestenbaum and J. W. Englund, *A Drift Transistor for High Frequency Use*. RCA Laboratories Bulletin LB 1045.



R1—120,000 ohms, ½ watt, 10%
R2—1,000 ohms, ½ watt, 10%
C1—4.5–25 $\mu\mu$f trimmer
C2—47 $\mu\mu$f, mica
C3—820 $\mu\mu$f, mica
C4—.0047 μf, ceramic
BATT—3–6 volts
L—see text
S—spst slide
V—2N247
XTAL—1.5—14 mc as desired
Xtal socket—to match crystal
Socket, subminiature 5-pin in-line for transistor
Case, 2⅞ x 2 x 1 inch (Lafayette MS-158 or equivalent)
Miscellaneous hardware

Circuit of the 1-transistor unit.

Eliminate just three faults of most ohmmeters and you can come up with a precision instrument

By H. B. CONANT*

THOSE who must measure resistance precisely know that ohmmeters are not accurate and the average technician who has a few years' experience becomes suspicious of the instrument. It is a rare ohmmeter that gives readings within 10% of the true resistance value. Check yours against a group of precision resistors and see.

Traditionally, an ohmmeter's circuit is some version of Fig. 1. This is based upon the equation $R = \frac{E}{I}$, where E is the battery potential, I the current indicated by a dc meter and R the *total* circuit resistance in series with the battery. This includes limiting resistor R_L, variable resistor R_V, the unknown resistor R_X plus the resistance of the meter, test leads, switch contacts, wiring and even the battery.

To set the meter, we short the test prods and adjust R_V to give a zero-ohms reading. In this way, we adjust the value of R to suit the battery potential, and at this point the ohmmeter is obviously correct.

*Conant Laboratories, Lincoln, Neb.

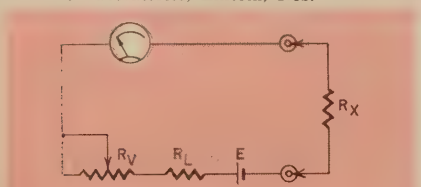


Fig. 1 — Traditional ohmmeter circuit.

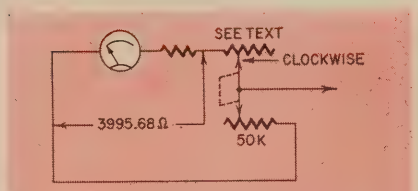


Fig. 2 — Zero-adjust control that does not change total circuit resistance.

Why then is the ohmmeter inaccurate? There are a number of reasons:

▶ A fresh D cell delivers as much as 1.65 volts and can be used until its voltage has dropped below 1.35. So, if the circuit in Fig. 1 uses a single cell and a 1-ma meter, R must be adjustable between 1,350 and 1,650 ohms. Now, if we measure an unknown resistance and the meter indicates exactly half-scale $(\frac{1}{2}I)$; $2R = \frac{E}{\frac{1}{2}I}$. Obviously R_X is equal to R or something between 1,350 and 1,650 ohms, regardless of what the center-scale graduation on the scale says it is. All partial-scale deflections are similarly related to R, regardless of the battery potential or the meter sensitivity.

▶ The ohms scale was originally plotted according to the engineer's best judgment of how it should be proportioned. Scales were then printed and installed on 2% accurate dc meters. Commercial 2% meters can be off as much as one scale division of a 50-division scale.

▶ Because of overdamping of the meter movement on low-resistance ranges, the pointer creeps rather than swings up the scale, so pivot friction prevents the pointer from reaching the true scale position.

Eliminate the error

To build a precision ohmmeter, we must eliminate the causes of error.

Since all the resistance-scale graduations are unalterably related to R, the first step is to eliminate R_V from Fig. 1 so R can be made a fixed and precise value. As this is the value indicated at the half-scale point, we will want it to be in round numbers. With a fixed value for R, variations in battery voltage (E) must produce proportional variations in I—for example, $2E/R = 2I$. Since we have eliminated R_V the "ohms zero" control must vary the current sensitivity of the meter without, however, altering its resistance. The ideal

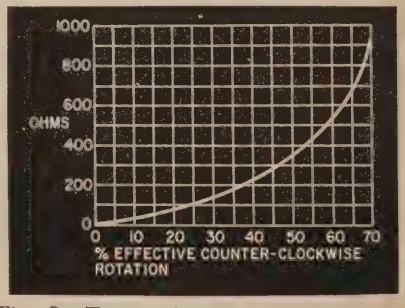


Fig. 3—Taper of pot in meter leg of zero-adjust circuit.

way to do so would call for a movable magnetic shunt inside the meter case, operated by a control on the panel. Meter current requirements must be increased only 20% with such a shunt to cover the variations in battery voltage.

Zero-adjust control

Using a conventional meter, this job becomes difficult because we must use circuitry which will shunt the meter to varying degrees without changing its resistance. Fig. 2 shows how this can be done. As the shunt control is turned to decrease its resistance, the resistance of the series control increases the resistance of the meter circuit to hold the resistance of the parallel circuit constant.

Since resistances in parallel do not have a linear relationship to variations in the value of a single resistor, either the shunt or series section of the dual control must be tapered. The resistance of the series control is much lower than that of the shunt, so the taper should be in the series control for ease of construction.

Before we can calculate resistance values and tapers, we must know the internal resistance of the meter we will use. But don't measure its resistance in the usual manner—you may damage the meter. Instead, connect it in parallel with a dc millivoltmeter of known accuracy and supply both with current from a dry cell through a resistance which is adjusted until the meter reads exactly full scale. Note the millivoltmeter reading. Then connect the meter in series

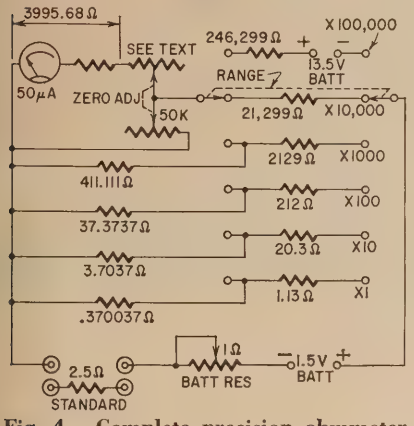


Fig. 4—Complete precision ohmmeter.

with a microammeter of known accuracy, the dry cell and the resistance. Again adjust for full-scale meter reading. Note the microammeter reading. Knowing both the full-scale voltage and current, E/I = R will tell you its internal resistance.

Since a 50-μa meter has for some years been the standard movement in vom's, we will calculate values for our precision ohmmeter around such a unit which is nominally 2,000 ohms and 100 mv. The procedure is the same for any dc meter.

We want to use a single cell for as many ranges as possible, so we find the resistance which passes 50 μa from our lowest battery voltage, 1.35. This is 27,000 ohms. But we must allow some current for the shunt so we try 25,000 ohms. It will pass 54 μa at 1.35 volts and 66 μa at 1.65. Therefore, the current through the shunt must vary between 4 and 16 μa.

Now before we find the shunt's value, we must plan to avoid overdamping the meter on low-resistance ranges. To do so we add resistance approximating that of the meter (2,000 ohms), making the effective meter resistance 4,000 ohms to drop 0.2 volt at 50 μa. The maximum resistance of the shunt control section must be 0.2/.000004, or 50,000 ohms.

Parallel-resistance calculations (R1 × R2)/(R1 + R2) give us 3,703.7 ohms as the resistance of 50,000 and 4,000 ohms in parallel. It is easier to round this value out to exactly 3,700 ohms when building the meter. Now we use a variation of the equation for parallel resistances. R is the desired value (3,700 ohms), R1 is the known value of one

(*Continued on page* 88)

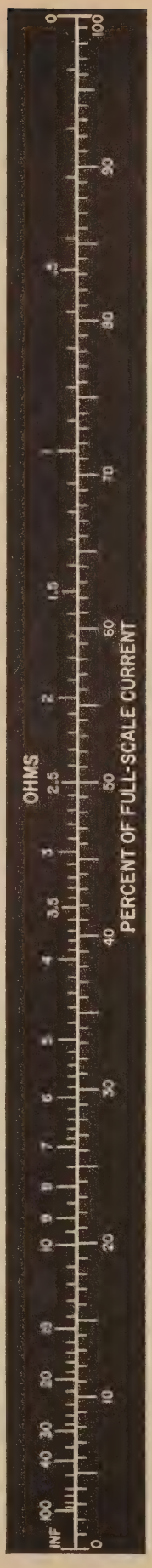
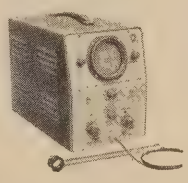


Fig. 5 — Diagram of meter scale in ohms vs percent of full-scale current.

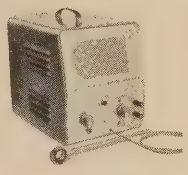
SIMPLIFY TEST and TROUBLE-SHOOTING PROCEDURES

with

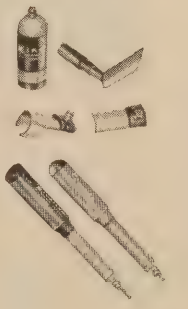
KINGSTON TEST EQUIPMENT



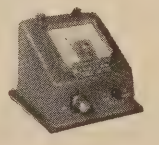
Models EA-1 and VS-5 Kingston Absorption Analyzers provide electrostatic signal tracing and extreme sensitivity. For trouble-shooting any equipment with wave forms. CRT displays wave-form from each stage.



Model PO-1 Kingston Absorption Analyzer allows conventional oscilloscopes to be used in trouble-shooting electrostatically. Built-in speaker for use as an audio analyzer.



Accessory Probes for miniature, sub-miniature and shielded tubes. Also Direct Probe for use with VS-5 and EA-1. Transistor Radio Probe simplifies trouble-shooting of transistorized radios.

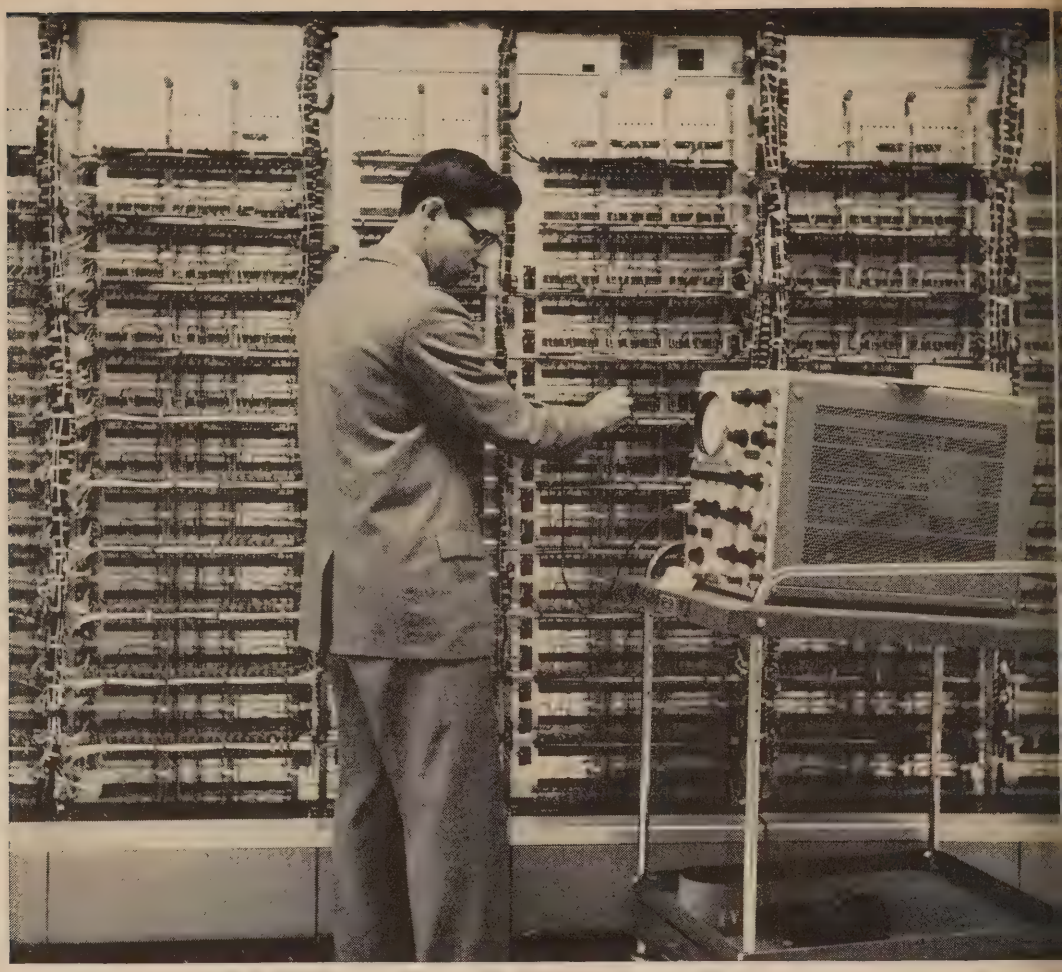


Model BB-1 Variable DC Source, battery-driven for use wherever a pure DC voltage is desired. Voltage can be varied and metered.

Probe-Master. Built-in capacitive network allows by-passing of stages, coupling of signals from one stage to another. Most versatile testing probe on the market. Complete with two clips and neon bulb.

WRITE TODAY FOR CATALOG

KINGSTON ELECTRONIC CORPORATION
MEDFIELD, MASSACHUSETTS, U. S. A.



Watching oscilloscope, Bill Wilkerson tests SAGE computer circuitry.

Adjusting SAGE computer operating console.

Bill Wilkerson instructs Field Engineers on new computer program.

How far can you go in electronics... without a degree?

Three years ago, young Air Force veteran William H. Wilkerson set out to find a career in electronics, but he had no industrial experience and no engineering degree. Today, he has a solid electronics education, he is supervising the maintenance of a highly advanced electronic computer, and his future is bright. Here's how it happened...

SOUGHT ELECTRONICS CAREER

"I was anxious to go to college when I left the service in 1956," recalls Bill Wilkerson. "The Air Force had given me some fine training in electronics, enough to arouse my interest and make me want to learn a lot more. An engineering education seemed to be the answer, but family responsibilities made college impossible.

"I still wanted to work in electronics, however, so I started looking into technician jobs. Most big companies offered me no more than a seat at a test bench eight hours a day —dull, routine work that provided little or no opportunity to learn and grow. All the interesting assignments, it seemed, called for a college degree. Then I had an interview with IBM and found just what I was looking for in the SAGE Field Engineering Program."

WHAT IS SAGE?

SAGE is a vital part of our country's air defense. To help guard against surprise aerial attacks, SAGE partitions America into several defense sectors. At the heart of each sector is one of the fastest and most reliable electronic computers in the world. This computer receives radar data from many points, checks this against known air traffic in its sector, and makes it possible for Air Force operators manning the computer to identify immediately all flying objects as friendly or hostile. If need be, the computer can also guide a BOMARC missile to an enemy target.

THOROUGH COMPUTER TRAINING

On joining IBM, Bill Wilkerson was given 20 weeks' computer training as a Field Engineer. He learned how to maintain the various electronic units used in a SAGE computing system, how the SAGE computer itself helps diagnose and locate problem areas, and how to make fast, precise repairs without interfering with computer operation. "It was an excellent education—both in the theoretical and practical aspects of electronics," he says. "Furthermore, you have plenty of opportunities to keep up with new developments in this fast-changing field. After assignment to a SAGE site, for example, you may take courses—during regular working hours—on such subjects as improved output methods or new magnetic 'memory' devices. You may also be selected for additional training to learn the total functioning of a large-scale electronic data processing system."

ASSIGNMENTS ROTATED

Bill Wilkerson is now a Field Engineering Group Supervisor at a SAGE site. "I help my Group Manager keep the computer in top working condition," he explains. "Together, we provide technical supervision to the Field Engineers in our group and schedule daily maintenance checks to spot computer problems before they develop into breakdowns. An important part of my job is to make up daily assignment sheets, carefully rotating responsibilities so that each Field Engineer moves from one computer unit to another. This 'cross-training' gives each man a chance to become familiar with all the parts of a large-scale computing system and helps him add to his general electronics knowledge."

RAPID ADVANCEMENT

"When I was first interviewed, I was told that IBM promotes from within," Bill Wilkerson says. "I've found this to be true. In the SAGE computer program, you begin as a Units Field Engineer. Then, depending on your abilities, you can advance rapidly to Systems Field Engineer, Group Supervisor, Group Manager, and on up the line. Every employee receives frequent career counseling to review his progress and to chart his future. In this Company, there are plenty of opportunities for the man who wants to grow and is willing to apply himself."

Bill Wilkerson cites his own career as an example. Since joining IBM three years ago, he's had several promotions, culminating in his present supervisory post. "It's a wide-open field," he says.

A BRIGHT FUTURE

Although other areas for promotion are open to him, Bill Wilkerson would like to stay in technical management because, as he says, "Frankly, I hardly believed back in '56 that a man like myself without a college education could go so far so fast, have still higher goals—and find such solid help in reaching them."

* * * *

If you have a minimum of 3 years' technical schooling—or equivalent experience—you may be eligible for advanced training for 20 weeks as a Computer Units Field Engineer. Starting salaries are based on your education and experience. While training you will also receive a living allowance.

From then on, you can go as far as your abilities and ambition will take you. And, as you may already know, at IBM you receive company-paid benefits that set standards for industry today.

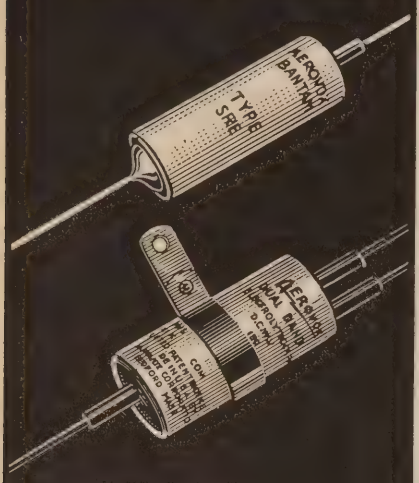
WRITE TODAY TO: Mr. N. H. Heyer, Dept. 649M
Federal Systems Division
IBM Corporation
Kingston, N. Y.

You'll receive a prompt reply. Personal interviews arranged in all areas of the United States.

IBM®

INTERNATIONAL BUSINESS MACHINES CORPORATION

SUPERIOR SERVICE



AEROVOX
TUBULAR
ELECTROLYTICS

The most popular 'lytics used in TV and radio service. Long established favorites with all service-technicians, Aerovox electrolytic capacitors can be counted on for dependable performance.

PRS DANDEES . . . compact tubular units in aluminum cans with cardboard insulating sleeves. Available in singles, duals, triples and quads as well as AC rated and non-polarized units. Multiple units are furnished with insulated stranded wire leads 5" long. Available in a wide range of capacity and voltage combinations.

SRE BANTAMS . . . smaller than the PRS type but perfectly capable of handling full size loads. Hermetically-sealed in aluminum cans and furnished with cardboard insulating sleeve. Available in voltages of 3, 6, 12, 15, 25, 50, 70 and 150 VDCW in all popular capacities.

For "Off-the-shelf" delivery on these and other Aerovox capacitors see your local Aerovox Distributor.

AEROVOX CORPORATION
DISTRIBUTOR DIVISION
NEW BEDFORD, MASS.

TEST INSTRUMENTS

(*Continued from page* 85)

leg (50,000 ohms) and the value of the other leg is $(R1 \times R)/(R1 - R) = 3{,}995.68$ instead of 4,000 ohms for the meter leg of the parallel circuit. We adjust the meter series resistor so that it plus the resistance of the meter totals 3,995.68 ohms.

The effective meter terminal voltage at the extreme clockwise position of the dual control is 3,995.68 ohms times the meter current of 50 μa, or 0.199784 volt, corresponding to current through the parallel circuit of 0.199784/3700 = 53.9956 μa.

Now we can calculate the taper needed in the series section of the control to hold the resistance of the parallel circuit at 3,700 ohms throughout the adjustment range. At a maximum current of 66 μa, we will have a 0.2442-volt drop across 3,700 ohms. At 50 μa, the resistance of the meter leg of the circuit must be 4,884 ohms. This means that at some point in the rotation of the dual control, we will have added 4,884 ohms minus 3995.68 ohms, or 888.32 ohms. This gives us a stopping point where we have calculated the essential part of the taper.

We assume that both sections of the control are made by the same manufacturer so that both contactors engage their respective resistance elements at the same instant. We now use the resistance of the linear 50,000-ohm section at each 5% of effective rotation (50,000, 47,500, 45,000, etc.) as R1 and find the values needed in the meter leg to keep R at 3,700 ohms. When we reach 4,884 ohms as the value of the meter leg, we have determined the essential portion of the taper. It should make a curve like Fig. 3.

The constant effective meter resistance is 3,700 ohms, so R_L must be 25,000 − 3,700, or 21,300 ohms. This will be the ×10,000 range of our ohmmeter. For a ×100,000 range, we simply switch in 13.5 additional volts in series with 250,000 − 3,700, or 246.300 ohms. As the full-scale current for the ×10,000 range is 54 μa, the respective currents for ×1,000, ×100, ×10 and ×1 are 540 μa, 5.4 ma, 54 ma and 540 ma, respectively. The fixed shunt for any range is the value which passes the full-scale current minus the 54 μa of the meter circuit at the 54-μa meter-circuit terminal voltage of 3,700 ohms × 54 μa, or 0.1998 volt.

For an example, let's calculate the shunt and R_L for the ×100 range: 5.4 ma − 54 μa = 5.346 ma at 0.1998 volts = 37.37373737 ohms, as the value of the shunt. This in parallel with 3,700 ohms works out to exactly 37 ohms to make R_L 250 − 37, or 213 ohms.

All the calculated values are given in Fig. 4. For each value of R_L, 1 ohm has been deducted for the total of test lead, wiring, contact and battery resistance plus a fraction of 1 ohm set into the control marked BATT RES. After setting the ohms zero on the ×10,000

dapper?

Down to a point, though hardly well suited for public appearance *or* public address. If you want real top-to-bottom coverage, we suggest a selection from University's complete line of well-groomed speakers and accessories. They're all stylishly described in our new product catalog. It's FREE. Also, invest $1 in the all-new 64-page University Technilog, the authoritative reference book for planning P.A. speaker installations. See your local distributor, or write Desk J-9, University Loudspeakers, Inc., 80 So. Kensico Ave., White Plains, N. Y.

University®

THE WORLD'S MOST COMPLETE LINE
RADIAL • HIGH FIDELITY WEATHERPROOF • PAGING
WIDE-ANGLE • SUPER-POWER • SUBMERGENCE-PROOF
DIRECTIONAL • EXPLOSION-PROOF • TALK-BACK

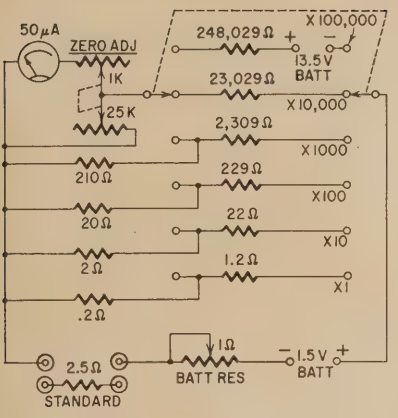


Fig. 6 — Semi-precision ohmmeter is somewhat easier to build than the unit shown in Fig. 4.

range, switch to ×1, connect test prods across the 2.5-ohm standard resistor and adjust the BATT RES control to center scale on the meter. On this ×1 range, upper-scale readings will be a little high and lower-scale readings a bit low because of the heavy current drain and the nonlinear current vs resistance characteristic of the battery. Battery resistance error can be minimized by using a larger dry cell—even a No. 6 if the ×1 range is important to you. If not, simply dispense with the ×1 range and use an ordinary size-D flashlight cell.

Resistance scales

The ohms scale is laid out mathematically since we have seen that any scale point is related to the value of R. Scale graduations should be in terms of percent of full-scale current, and for convenience we will calculate the ×10 range whose value of R is 25 ohms and will use 25 (higher than the usual voltage, but selected to simplify calculations) for the value E so that $25/25 = 1$, or 100%. The current I is $25/(25 + R_X)$ so the 50-ohm point lies at $25/75 = 0.333333$ times full-scale current. If the scale is laid out in % of scale arc instead, some grave errors may show up at some parts of the scale. The proper scale will be proportioned like Fig. 5, and the more points calculated and drawn into the scale, the greater the ease of reading the meter accurately.

Another circuit

Some may be just as happy with the semi-precision ohmmeter shown in Fig. 6. Linear controls are used and are set up and connected as shown, with a resistor instead of the actual meter to avoid damaging the meter. The resistance of the parallel circuit is then measured at each 5% of rotation and each reading noted, to about 70% of rotation. Now take the difference between the highest and lowest resistance readings and also find the average between high and low. Divide the difference value by 25,000 to get approximately 1% (±0.5%). The average figure is adjusted to a round number,

from England...

where the finest is a tradition

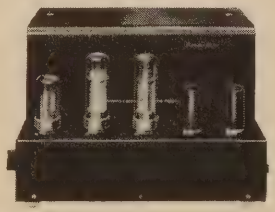
Model SL 71 Stereo Two Speaker System 40-20 cps complete. $89.95 Audio Net

Stereophonic High-Fidelity by ***Beam-Echo***

Model SPA 21—50-watt Stereo High Fidelity "3-D" Amplifier. $229.95 Audio Net

Model BM611—Deluxe Automatic FM-AM Tuner. 8 tubes plus rectifier; magic eye; neon balancing; illuminated panel. $149.95 Audio Net

Model SPA 11—30-watt Stereo High Fidelity "3-D" Amplifier. $149.95 Audio Net



Model DL 7-35 Basic 50-watt Amplifier (100 watts peak). With 2 units: 100-watt stereo with SP 21; 200 watts peak stereo. $159.95 Audio Net

Model SP 21 Stereophonic-Monophonic Pre-Amplifier Control Unit. $159.95 Audio Net

traditionally the finest!—and very likely the only sound reproducing equipment to represent a lifetime investment in *timeless* listening enjoyment. The rewards of owning Beam-Echo are many; among them the knowledge that yours is—and will remain—the best quality stereophonic-high fidelity ever produced.

1 YEAR FULL WARRANTY ON ALL COMPONENTS; TUBES 90 DAYS.

Prices slightly higher west of the Rockies.

BEAM-ECHO INTERNATIONAL, LTD., Dept. RE-1
820 Greenwich St., New York 14, N.Y.

PLEASE SEND ME FREE CATALOG AND NAME OF NEAREST DEALER.

Name_____

Address_____

City_____ Zone____ State_____

Do YOU Know

. . . the field of ELECTRONICS is the most advanced and fastest growing in the world, offering the largest range of jobs for technicians and engineers in history?

Do YOU Know

. . . PHILCO TechRep is the world's largest Field Service organization and because of this leadership can offer you—

- unlimited advancement
- opportunity to work any place in the world
- experience in the most advanced fields of electronics and guided missiles
- personal security, real challenge, top salary and compensation for your skills

Do YOU Know

- Philco electronic experts help prepare you for your TechRep Service career
- Philco's especially written Home Study Course keeps you posted on latest electronic techniques, including radar, guided missiles and transistors
- Philco provides financial assistance to continue your education

Do YOU Know

. . . Philco not only will help you select the position in Electronics best suited to you but can and will provide you with periodic reports as to the openings in our world-wide organization for which you may be qualified.

Get The FACTS About Your Future With Philco:

Send Now to Dept. 21
for The Complete Story on What Makes The Philco TechRep Division —

"First In Employment Opportunities"
PHILCO TECHREP DIVISION
22nd & LEHIGH AVE., PHILADELPHIA 32, PA.

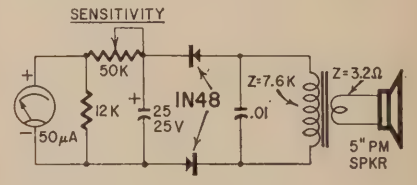
which is the value to be deducted from 25,000 to find the value of R_L. As shown, the circuit will overdamp the meter on low-resistance ranges. However, you can use carbon controls to get a 50,000–1,500-ohm combination to permit inserting the 2,000-ohm meter series resistor as in Fig. 4. The shunt values will have to be doubled, and effective average meter resistance calculated with the shunt in circuit to find the value of R_L. The 25,000–1,000-ohm combination shown is available as IRC part Nos. WPK-25,000 and WM-1,000. Characteristically, this "poor man's precision ohmmeter" is least accurate on the $\times 10{,}000$ range (within $\pm 1\%$) but 10 times as accurate on the $\times 100{,}000$ range. Going to the lower-resistance ranges, the error progressively decreases and would practically vanish on the $\times 1$ range if battery resistance fluctuations didn't appear. Battery resistance errors even on the $\times 1$ range are still small, especially if a No. 6 is used. END

Sound-Intensity Indicator

By WM. R. SHIPPEE

THIS simple indicator can be used as an applause meter or can be calibrated to read decibels. As the circuit layout is not critical, the unit can be mounted in any type of enclosure. It requires no power source and is very easy to operate. The indicator receives all its power from sound waves moving the voice coil of the speaker in and out of the speaker magnet.

The transformer is an inexpensive audio output unit. A Stancor A-8114 or similar type is satisfactory. The speaker may be any small PM type with a



Circuit of the batteryless sound meter.

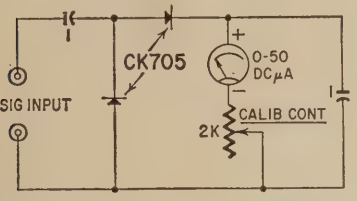
3.2- to 4-ohm voice coil. Keep leads from the speaker to the transformer as short as possible. The sound indicator's sensitivity is controlled by a 50,000-ohm carbon potentiometer. The small resistor in parallel with the meter is used as a damper. Its exact value should be determined experimentally as the internal resistance of the meter will affect it. The crystal diodes rectify the audio-frequency voltages and may be 1N48's or any similar type. The two diodes used, however, should both be the same type. The meter is a 50-μa unit picked up at a surplus dealer. If this meter were purchased new, Lafayette Radio also sells an inexpensive unit—TM-70, $7.50. END

TEST INSTRUMENTS

SQUARE-LAW AUDIO MILLIVOLTMETER

By RUFUS P. TURNER

THE simple crystal meter circuit shown in the diagram gives full-scale deflection with only 100 mv rms input. The response is square-law. Input impedance is approximately 2,000 ohms at 1,000 cycles. This instrument may



Eight components, including the input jacks, are all you need to build this simple instrument.

also be used as a 0–50 ac microammeter having an insertion impedance of 2,000 ohms.

The circuit must be individually calibrated. Apply an accurately known 100-mv rms signal to the input terminals and adjust the calibration control rheostat for full-scale deflection of the microammeter. Then check the deflection for signal inputs of 90, 80, 70, 60, 50, 40, 30, 20, 10 and 5 mv.

This simple circuit holds its calibration surprisingly well. Because so few small components are required the entire circuit can be assembled in a meter box.

For rf operation, reduce the value of the two capacitors to .01 μf each. However, this will make audio response fall off. END

CORRECTIONS

In the article "2-Way Radios for Citizens Band" in the December issue the diagrams for Figs. 3 and 4 were inadvertently transposed. Our thanks to Walt Miller, of Elmont, N. Y., for bringing this to our attention.

In the December, 1959, issue the author of "Photographing TV Dx" (page 105)was incorrectly listed as George E. Simkin. The correct name is *Gordon E. Simkin* (K7JUK) well-known TV dxer and active member of the American Ionospheric Propagation Association, whose name has appeared correctly many times in our magazine. Our apologies, Gordon.

Now Completely SELF-CONTAINED

For Testing & Rejuvenating BLACK AND WHITE and COLOR including 110° TUBES

NEW CRT 440

CATHODE REJUVENATOR TESTER

B&K

TESTS AND REJUVENATES all black & white and color picture tubes at correct filament voltage from 1 to 12 V.

TESTS AND REJUVENATES 110° tubes with 2.34, 2.68, 6.3 and 8.4 volt filaments.

TESTS AND REJUVENATES color picture tubes. Checks each color gun separately same as black & white tubes.

Used by Thousands of Professional Servicemen
MAKES NEW PICTURE TUBE SALES EASIER

Gives you more value than ever—all-in-one. Quickly checks and corrects most TV picture tube troubles in a few minutes right in the home without removing tube from set. Gives new useful life to weak or inoperative tubes. Checks leakage. Restores emission and brightness. Repairs inter-element shorts and open circuits. Life test checks gas content and predicts remaining useful life of picture tube. Completely self-contained in leatherette-covered carrying case. Net, $69.95

ACCESSORIES for USE ONLY with FORMER B&K Models 400 and 350 CRT

Model C40 Adapter. For use only with all previous B&K Model 400 and 350 CRT's. Tests and rejuvenates TV color picture tubes and 6.3 volt 110° picture tubes. Net, $9.95

Model CR48 Adapter. For use only with all previous B&K Model 400 and 350 CRT's. Tests and rejuvenates 110° picture tubes with 2.34, 2.68, and 8.4 volt filaments. Net, $4.95

See your B&K Distributor or Send now for Bulletin ST24-E

B&K MANUFACTURING CO.
3726 N. Southport Ave. • Chicago 13, Illinois
Canada: Atlas Radio Corp., 50 Wingold, Toronto 10, Ont.
Export: Empire Exporters, 277 Broadway, New York 7, U.S.A.

authors.. Industrial Electronics

Our new Industrial Electronics section offers opportunities for a new type of article. Are you engaged in the maintenance or manufacture of commonly used industrial electronic equipment? Are you an industrial technician with industrial accounts? Then you may have experience and knowledge that you can make pay off in RADIO-ELECTRONICS articles. Write for our Authors Guide and more information on writing in the field of industrial electronics.

newest knight-kits® . . . years-ahead

A PRODUCT OF ALLIED RADIO

incomparable *knight-kit* stereo hi-fi saves you up to 50%

DELUXE 40-WATT STEREO AMPLIFIER KIT

Y-774D

$79.50

$5 Down

Finest hi-fi stereo amplifier you can buy in money-saving kit form. Features special full-frequency range, extra center-channel output for 3-speaker systems. Dual built-in equalized preamps accommodate every existing sound source; exceptional control versatility, including single knob channel balance and separate dual concentric tone controls for each channel. Outputs for stereo tape recording. Exclusive printed circuit switches and plug-in units for easy assembly. Custom-styled in Cordovan gray vinyl plastic bonded to steel; Desert Beige and Sand Gold extruded solid aluminum escutcheon; 4⅛ x 15½ x 11¼". Shpg. wt. 24 lbs.

Model Y-774D. 40-Watt Stereo Amplifier Kit. **$5 DOWN**

DELUXE STEREO FM-AM TUNER KIT

Y-731D

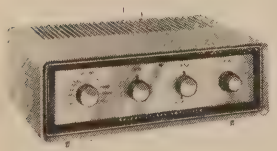
$87.50

$5 Down

Distinguished for quality and styling, years-ahead in features. Has completely independent FM and AM sections, each with moving-bar "magic eye" tuning indicator. Only tuner kit with Dynamic Sideband Regulation (DSR) on FM for purest, distortion-free reception. Sectionalized construction permits easy addition of "built-in" multiplex. Has 2½μv sensitivity. Double limiter-discriminator FM circuits—adjustable AFC. Separate cathode-follower outputs on FM and AM with level set controls. Precisely aligned RF and IF transformers in FM section. Printed circuit boards for fastest, easiest assembly. Styling matches the 40-watt amplifier; 4⅛ x 15½ x 12". Shpg. wt., 18 lbs.

Model Y-731D. Stereo FM-AM Tuner Kit. **$5 DOWN**

there is a money-saving *knight-kit* for every hi-fi need



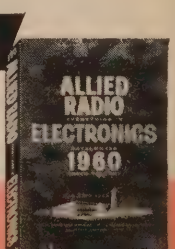
20-Watt Stereo Amplifier
Truly a super-value. Built-in equalized preamps; single-knob selector switch for control convenience; dual concentric, clutch-type level control. 17 lbs.
Y-773D. *$2 Down.* Only **$44.50**

FM-AM Hi-Fi Tuner Kit
Amazing buy, featuring: Tuned RF stage; high sensitivity; AFC; flywheel tuning; pre-aligned IF and RF coils; cathode follower output. Truly great value. 14 lbs.
Y-787D. *$2 Down.* Only **$49.95**

18-Watt Hi-Fi Amplifier Kit
A brilliant performer at unbelievable savings. 18 watts at only 0.5% distortion; RCA 6973 audio output tubes; 8 inputs; 7 record equalization settings. 15 lbs.
Y-797D. *$2 Down.* Only **$39.95**

SEE THEM ALL
See the impressive selection of Hi-Fi Knight-Kits (including speaker systems) in the money-saving 1960 ALLIED Catalog. If you haven't a copy, send for it today.

FREE



ONLY $5 DOWN (OR LESS) on orders up to $200; up to 24 months to pay. Fast handling—no red tape—take advantage of these easiest-pay terms . . .

for you who want to build the very best for less . . .

all-new *knight-kit* citizens band transceivers...2-way radio everyone can afford

CITIZENS BAND SUPERHET TRANSCEIVER KIT

Y-712D
$79.95
$5 Down

A high-sensitivity do-it-yourself transceiver for efficient, economical 2-way radiotelephone communication. Any citizen, 18 or older, can get a license—no exam required. For mobile or stationary use. Covers up to 20 miles, depending on antenna height and terrain. Works just like an intercom, with talk-listen operation. Receiver is sensitive superhet; tunes all channels continuously. 5-watt transmitter section. Built-in AC power supply. With transmitting crystal (available for any channel from 1 to 22—specify preference) and doublet antenna. Extras available: Y-723, 6-12 v. DC power supply, $10.95; Y-729 vertical antenna, $6.50; Y-714 mobile mounting bracket, $5.35. Distinctive high-impact styrene case; 5 x 12 x 12". Shpg. wt., 20 lbs.

Model Y-712D. Superhet Transceiver Kit. **$5 DOWN**

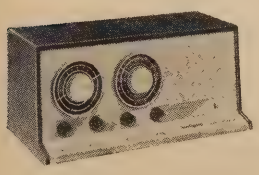
CITIZENS BAND TRANSCEIVER KIT

Y-713D
$39.95
$2 Down

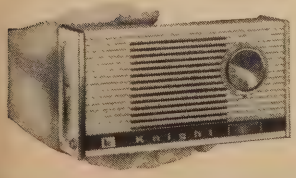
Low-cost super-regenerative receiver and 5-watt transmitter kit. Readily fits car, boat or desk. Simple, one-switch operation permits talk or listen. Receiver tunes all 22 channels continuously. Built-in AC power supply. With mike, transmitting crystal—specify channel (1 to 22) if you have a preference—and doublet antenna. Handsomely styled case; 6 x 10 x 8". Designed for easy assembly and dependable operation. Available extras: Y-723, 6-12 v. DC power supply, $10.95; Y-729 vertical antenna, $6.50; Y-724 mobile mounting bracket, $5.35. Shpg. wt., 10 lbs.

Model Y-713D. Transceiver Kit. **$2 DOWN**

dozens of exciting hobbyist kits available

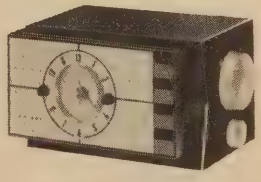


"Span Master" 4-Band Radio Kit
Famous for world-wide short-wave and broadcast reception. True band-switching; continuous 4-band coverage from Broadcast to 30 mc. Sensitive regenerative circuit; 4" PM speaker. With cabinet. 8 lbs.
Y-258D. *$2 Down* Only..... **$25.95**

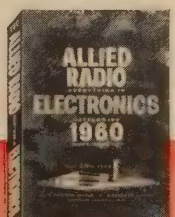


5-Transistor Portable Radio Kit
Popular, low-cost personal portable. Fun to build; superhet circuit; only 22 ounces; big 3½" speaker; built-in ferrite loopstick; phone jack. (Less battery, $1.30.) 2 lbs.
Y-771D. *$2 Down.* Only..... **$25.95**

"Ranger" Clock-Radio Kit
Easiest superhet of all to build—plug-in modules and printed circuit board eliminate small parts assembly. Excellent AM broadcast reception. Telechron clock has "sleep" switch. With appliance outlet. 6 lbs.
Y-737D. *$2 Down.* Only..... **$24.95**



SEE THEM ALL: Knight-Kits offer the most exciting hobbyist kits available. See the complete selection in the 1960 ALLIED Catalog. Write for it now—use coupon on page following.



FREE

manufactured and sold exclusively by **ALLIED RADIO** 100 N. WESTERN AVE., CHICAGO 80, ILL.

newest knight-kits® ... years-ahead

A PRODUCT OF ALLIED RADIO

knight-kits break through the professional instrument price barrier

5" LAB DC SCOPE KIT WITH IVA

Y-611D

$285.00

(less preamps)

For the first time in easy-to-build kit form—a triggered sweep DC precision quality lab scope with plug-in **interchangeable vertical amplifiers** (IVA). Brilliantly engineered with an impressive array of professional features, including: crystal-controlled timing markers; DC amplifiers in both horizontal and vertical channels; electronically regulated power supply; sweep timing adjustable to 1%; built-in voltage regulated peak-to-peak calibrator. Three interchangeable vertical preamplifiers are available: high-gain differential, $35.95; wide-band (to 10 mc), $24.95; dual-trace, $48.95. **There is no other instrument like this in kit form**—here is laboratory precision quality and reliability at far less than the cost of any comparable factory-built unit. Shpg. wt. 50 lbs.

Model Y-611D. Lab DC Scope Kit. **$10 DOWN**

Available in March—reserve yours now

LAB AUTOMATIC AC VTVM KIT

Y-608D

$99.50

$5 Down

A major achievement in instrumentation! This all-new AC VTVM features **automatic range selection**—by means of an electronically-actuated self-seeking mechanism which **automatically** selects the proper range when you touch probes to the circuit under examination. Simultaneously, a front panel light indicates the range in use. Covers 11 ranges from 3 millivolts to 300 volts full scale; frequency response to 2.5 mc. Reads as low as 100 μv. Highly stable 3-stage amplifier has cathode follower output; ideal for use as preamp for other test equipment or for connection to scope for simultaneous wave form observation. Includes precise trigger circuits; regulated power supply; latest printed circuitry for easy assembly and quality performance. An exclusive Knight-Kit development—there is no other instrument like it on the market, in any form or at any cost. Shpg. wt. 13½ lbs.

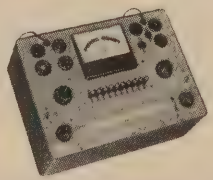
Model Y-608D. AC VTVM Kit. **$5 DOWN**

save on every instrument need with knight-kits... best by design

Famous-Value VTVM Kit

Measures DC voltage (11 meg. input) and resistance; AC voltage, rms and peak-to-peak. 4½" meter. Push-pull balanced bridge circuit. 7 lbs.

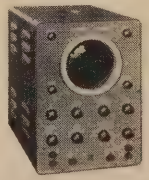
Y-125D. *$2 Down.* Only **$25.75**



Deluxe Tube Checker Kit

Checks over 700 receiving type tubes. 16 filament voltages. Tests cathode emission as well as shorts, open elements, etc. 15 lbs.

Y-143D. *$2 Down.* Only **$32.95**



5" Wide-Band Scope Kit

Top versatility. 5 mc bandwidth; DC coupled p-p output amplifiers; 25 mv/inch vertical amplifier sensitivity. Outstanding value. 29 lbs.

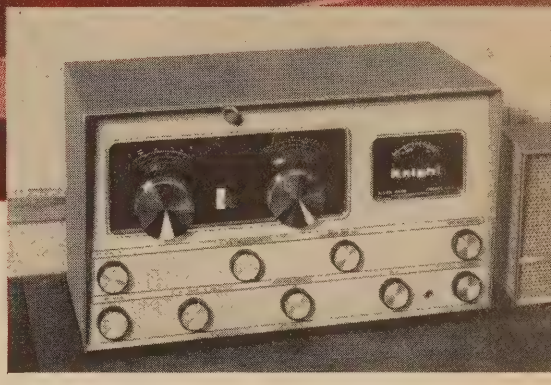
Y-144D. *$5 Down.* Only **$65.75**

SEE THEM ALL

You'll find dozens of other fine quality Knight-Kit instrument values fully described in the 1960 ALLIED Catalog. If you haven't a copy, write for it now—use coupon on opposite page.

FREE

electronic achievements at half the factory-built cost



years-ahead *knight-kit* amateur gear

T-400 AMATEUR 400-WATT TRANSMITTER KIT

Y-716D
$395.00
400-Watt CW Transmitter

Truly the "dream" transmitter—has what it takes to punch out a QRM-busting SSB, AM, or CW signal. 600 watts P.E.P. input on SSB; 400 watts on AM and CW. Covers 80, 40, 20, 10, and 15 or 6 meter bands. Start with the basic CW kit— then add AM and SSB accessory units and other "add-ins" whenever you wish. Has heterodyne VFO to assure a signal which "stays put." Tremendous 14" dial is precision-calibrated for all bands, 80 through 6 meters. SSB features: front panel controls—VOX, anti-trip and adjustable speech compression. Smooth, chirpless screen-clamp keying, plus VFO keying for complete CW break-in. Has 7034/4X150A final—coasts along well within its CCS ratings; silicon rectifier power supply runs cool. Dozens of advanced features put this job in a class all its own. Shpg. wt. 140 lbs.

$10 DOWN

Model Y-716D. T-400 CW Transmitter Kit.

Available in March—reserve yours now

"Add-In" Accessories: SSB Generator Kit, $69.95 • AM Modulator Kit, $24.95 • Speech Amplifier Kit, $9.95 • Monitor Scope Kit, $37.95 • 6-Meter Conversion Kit, $7.50.

R-100 AMATEUR RECEIVER KIT

Y-726D
$104.50
$5 Down

Incomparable receiver kit with all the features, selectivity and sensitivity of high-priced commercial units. Tunes 540 kc to 30 mc in 4 bands; calibrated bandspread on all Ham bands; 300 cps to 4.5 kc selectivity; exclusive printed-circuit bandswitch; built-in Q-multiplier; constant-running HFO—dozens of other professional features. Truly superior kit value. 30 lbs.

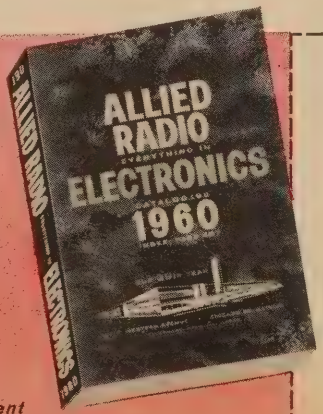
$5 DOWN

Model Y-726D. R-100 Receiver Kit.

Y-727D. S-Meter Kit for above, only..... $10.75
Y-728D. 4" Matching Speaker, only..... 7.50

FREE Send for the 1960
ALLIED CATALOG

Describes the complete KNIGHT-KIT line in detail—the leading Buying Guide for **everything** in Electronics. Send for your FREE copy. Use coupon at right.



ALLIED RADIO

Pioneers in quality electronic kit development

OUR 39th YEAR

ALLIED RADIO CORP., Dept. 132-A
100 N. Western Ave., Chicago 80, Ill.

Ship me the following KNIGHT-KITS:

Quantity	Description	Model No.	Price

$ ..... enclosed. (For parcel post include postage; express shipped collect)

☐ **Send FREE 1960 ALLIED CATALOG**

Name_____

Address_____

infrared guides missiles

The hot gasses of an enemy jet or rocket powered plane become the target for infrared-guided missiles. They can even fly right up into the plane's tailpipe

By JAMES R. SPENCER*

RECENTLY, the US Air Force's F-104A Starfighter was armed with the Sidewinder, an infrared guided missile, to form a deadly aircraft-firepower combination. The 155-pound Sidewinder, a 9-foot missile that has been in use for more than 2 years, is guided to its target by infrared radiation emitted by the target. Thus the hot exhaust gases of an enemy plane become the target for this weapon. A Sidewinder, traveling at supersonic speeds, can actually zoom into the tailpipe of a jet aircraft to destroy it.

Although the actual guidance equipment aboard the Sidewinder is classified, many general questions concerning infrared and the use of infrared in homing guidance can be answered.

What is infrared?

Infrared is a form of electromagnetic radiation, similar to visible light and radio waves. It is generated by thermal agitation and radiated by everything at a temperature above absolute zero (− 273°C). High temperatures create more thermal agitation than low temperatures, so the infrared radiated by a hot object is more intense than from a cool one.

The infrared portion of the electromagnetic spectrum ranges from 400,000,000 megacycles (the high limit where infrared borders on visible light) to approximately 1,000,000 mc (the low limit where infrared approaches the higher microwave frequencies). It is easier to measure infrared in terms of wavelength than frequency, so a standard unit of wavelength for infrared has been adopted. This unit is the micron—1 micron is 1/10,000 centimeter long.

The infrared portion of the spectrum is divided into three portions (see Fig. 1)—the near infrared from 0.75 to 1.5 microns; the middle infrared from 1.5 to 10 microns, and the far infrared from 10 to 300 microns. The horizontal scale in Fig. 1 is logarithmic.

Infrared radiation can travel astronomical distances. The warmth from sunlight is infrared radiation that has traveled 93,000,000 miles. Only during the last few miles, when the radiation penetrates the earth's atmosphere, does it suffer any serious attenuation. Infrared is affected less by haze and light fog than visible light, but heavy clouds or rain can have a significant adverse effect.

At high altitudes where air-to-air combat is likely, above 30,000 feet, infrared radiation suffers little attenuation from the light, thin atmosphere.

Detecting infrared radiation

In the laboratory, thermal detectors can be used to pickup infrared radiation. They sense the heating effect caused by absorbing the radiation. However, this method can not be used for missile guidance.

Instead a photodetector forms the heart of the guidance system. In a photodetector, the absorbed photon energy either creates a voltage (photovoltaic cell) or causes a change in the conductivity of the detector (photoconductor). The photoconductive process is usually used because of the detector's small size, ruggedness and excellent infrared response characteristics. Lead sulphide photoconductors are one of the most extensively used types.

In general, photodetectors have response characteristics that limit their usefulness to the near infrared region and a small part of the middle infrared region. Fig. 2 shows the response curve of a typical lead sulphide cell as a function of wavelength. Note that the response peaks at about 1 micron and begins to cut off quite sharply at approximately 2.5 microns.

A recent development in photoconductors has extended their long-wavelength response. The new photodetectors are the indum antimonide and n- and p-type gold-doped germanium detectors. Fig. 3 shows one of them and the miniature cryostat (low-temperature thermostat) used to hold it at the normal

*Technical Editor, Philco TechRep Division *Bulletin*.

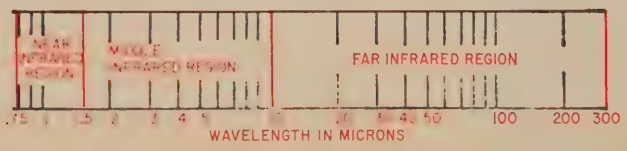


Fig. 1 — Infrared radiation spectrum showing the three infrared regions.

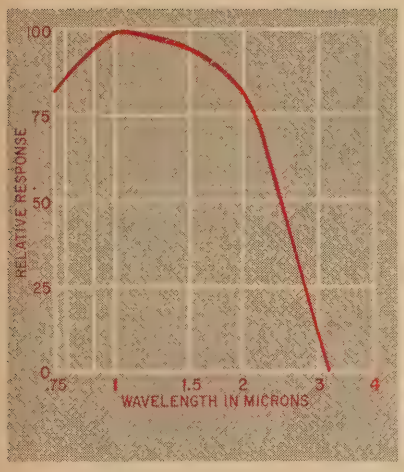


Fig. 2—Spectral response of a typical lead sulphide photocell.

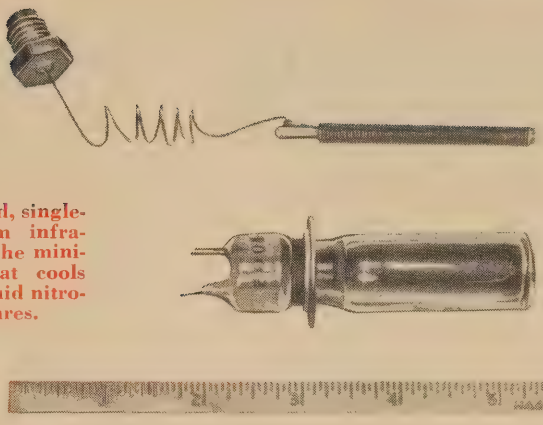


Fig. 3—Gold-doped, single-crystal germanium infrared detector with the miniature cryostat that cools the detector to liquid nitrogen temperatures.

operating temperature. Fig. 4 is a cross-section drawing of the detector's construction. The sensitive detecting elements are single crystals of indium antimonide or gold-doped germanium. Fig. 5 is the spectral response of an n-type gold–antimony-doped germanium detector. Compare this curve to the one for the typical lead sulphide cell (Fig. 2).

An optical system in the nose of the missile gathers infrared radiation emitted by the distant target and focuses this radiation upon the detector. Electrical signals from the optical system are combined with the amplified detector signal to give target direction information. These data are compared with the missile heading and the result is an error signal which is fed to a servo control system. The end result is that the heading of the missile is constantly corrected to keep it on a collision course with the target. The equipment necessary for infrared guidance is relatively simple and very compact. It is all contained within the missile—above the black band in Fig. 6.

With most guidance systems, the weakness is that the missile gets less and less accurate as it travels away from the guidance control source. But, if the source of control information is moved closer to the target, accuracy improves. For the ultimate in accuracy, the source of guidance control information should be at the target—and that's where the guiding infrared radiation originates.

Whether an infrared-guided missile can be fooled or not is classified data. But remember, both jet and rocket engines produce large quantities of heat. Removing the source of this infrared radiation from either a jet or rocket powered target also removes the target's source of propulsion. END

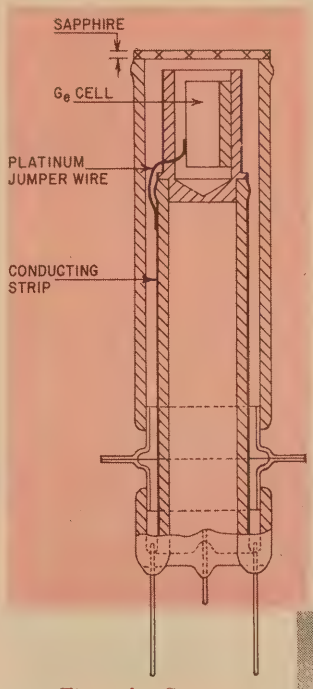


Fig. 4—Cross-section of the detector in Fig. 3.

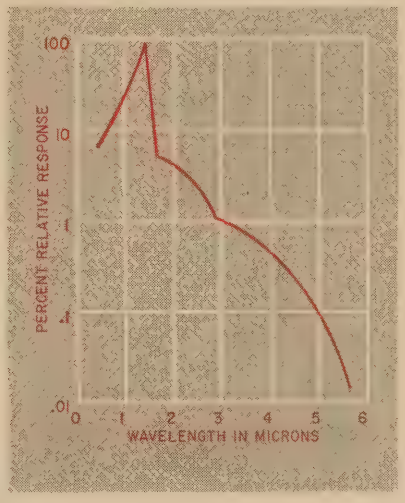


Fig. 5—Spectral response of a gold–antimony doped germanium infrared detector.

Fig. 6—The Sidewinder infrared-guided air-to-air missile. The detection equipment is all in the nose, above the black band.

BOGEN
the sound way to better business

which of these intercoms can you sell better?

Here's a pair of sales-producing, value-packed conversation pieces from *Challenger*...the budget-priced Bogen intercom line. Both of these time-and-step-saving, two-way intercoms are perfect for offices, restaurants, stores and homes...both backed by 27 years of expert sound-engineering experience. Which can you sell better to those half-dozen hot prospects *right on your street?*

CHALLENGER FUTURA.

Handsome, compact, popular-priced intercoms with performance characteristics that challenge much more expensive systems. Available in systems with 6 or 12 station capacity, either all-master, or one master plus remote stations. List prices: CHM6A (master): $49.95; CHM12A (master): $49.95; CHR (remote): $12.95.

CHALLENGER TWOSOME.

A low-priced, plug-together, two-station system, the Twosome is designed to fit any decor, any pocketbook. Comes complete with master station, remote station and 50 feet of wire. List price: $44.95. All prices slightly higher in the west.

BOGEN-PRESTO, DEPT. RE10, PARAMUS, N. J.
A Division of the Siegler Corporation

Please send me more information on the new Challenger Intercoms.

Name

Address

City Zone State

ELECTRONICS

More hints from a TRANSITHUSIAST'S WORKSHOP

Nine more aids for the transistor experimenter that will save him time and cash

By MARTIN KLEIN

HAVE you ever realized that the amplifier of your six- (or more) transistor radio will also make a handy signal tracer? Just run two leads from the amplifier input (usually the volume control) to a new jack. Make a simple probe with a capacitor and a diode, and you are all set (see Fig. 1). Of course, by leaving out the diode it becomes a general-purpose loudspeaker amplifier or audio signal tracer.

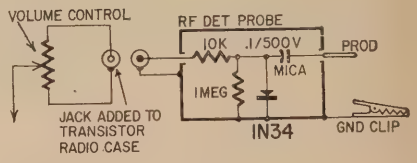


Fig. 1—Probe connected to jack added across volume control converts radio into portable signal tracer.

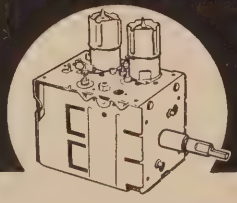
Mica for power transistors

Most manufacturers recommend using a thin sheet of mica to insulate a power transistor from its heat sink. You can get a good supply of these sheets by taking apart a large (0.1 μf or larger) mica capacitor. These usually consist of several dozen sheets which are coated with a metallic substance. Thin slices may be easily cut with a sharp razor blade, and the same tool will scrape off the metallic coating.

Transformer leads

The loss of a lead on a tiny trans-

TARZIAN Offers 48-Hour, Direct Factory Service on Tuner Repairs



only **$7.50**

That's right. Net, $7.50 per unit and $15 for UV combinations, including ALL replacement parts. 90-day warranty against defective workmanship and parts failure. Tuners repaired on approved, open accounts. Replacements offered at these prices* on tuners not repairable:

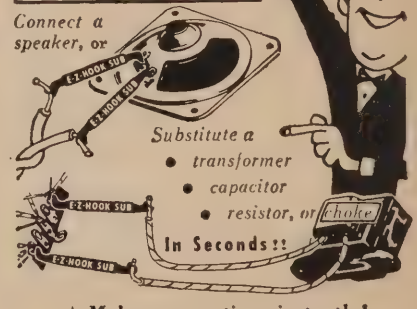
VHF 12 position tuner	$22.00
VHF 13 or 16 position tuner	23.00
VHF/UHF combination	25.00
UHF only	15.50

*Subject to change

Tarzian-made tuners are easily identified by this stamping on the unit. When inquiring about replacements for other than Tarzian-made tuners, always give tube complement ... shaft length ... filament voltage ... series or shunt heater ... IF frequency and chassis identification. Use this address for fast, 48-hour service:

SARKES TARZIAN, Inc.
Att.: Service Mgr., Tuner Division
East Hillside Drive
Bloomington, Indiana

SUBSTITUTE PARTS WITH-OUT SOLDERING
Quickly Easily with
Has 1001 Uses!
NEW E-Z-Hook "SUB" Connectors



★ Makes connections instantly!
★ Won't pull off!
★ Insures positive contact!
Saves time, money and parts in servicing, experimenting, instructing and production.

E-Z-HOOK SUB
No. 71-1 ....SUB.....Only 69¢ ea.
Six Colors!-for Easy Lead-Identification
ORDER THROUGH YOUR PARTS DISTRIBUTOR

E-Z-HOOK TEST PRODUCTS
SAFE • FAST • SURE
E-Z-HOOK TEST PRODUCTS
Dept. G-1 1536 Woodburn Ave.
Covington, Ky.

former can sometimes be even more disastrous than a broken transistor. The leads are usually not attached very firmly and, after losing two good transformers by accidentally pulling out the leads, I devised a simple method to put an end to this. Just take the leads of the new transformer and fold them back along the sides. Next tape them down (Fig. 2). This takes the pressure off the delicate connection and almost nullifies the chance of breakage. An even better way might be to mount the transformer on a tiny terminal board with lugs, but this might waste some of the precious room in a miniature project.

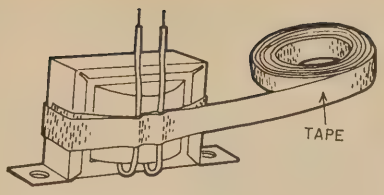


Fig. 2—Taping leads to transformer prevents pulling the leads out accidentally.

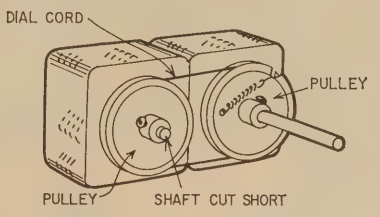


Fig. 3—Strap two miniature variable capacitors together and you have a dual unit.

Subminiaturizing

There is a simple way to subminiaturize the popular Raytheon CK722. Just slowly chip away the case of the transistor (filing is safer, but don't let friction generate too much heat) until you get to the inner metal shell. A careful job will yield a transistor almost 75% smaller, perfect for ultra-miniature work. Remember to keep track of the collector lead, since there is no red indicator dot on the inner metal case.

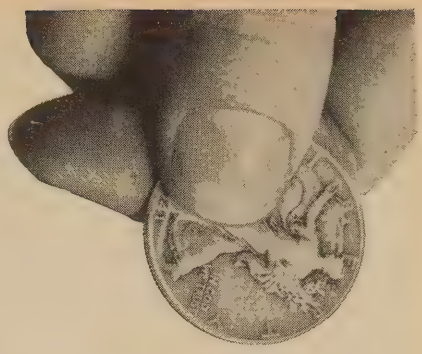
Regeneration controls

The builder of a transistor radio often finds that using subminiature pots as regeneration controls leaves something to be desired. Their range is crowded and it is often difficult to get that critical setting for maximum sensitivity. You will find that one of the small industrial types do a much better job. These tiny, multiturn potentiometers are ideal when you need very accurate settings.

Dual 365-$\mu\mu$f variable

Many transistor superhet circuits specify a dual 365-$\mu\mu$f variable. Unfortunately, this value has not yet come out in a dual unit of the really miniature type. You can make one out of two

(*Continued on page* 104)



take a tip from wigo

PRONOUNCE IT WEEGO

Not every speaker that looks good sounds good. Though Wigo may not be the best looking speaker in the world, it is one of the best sounding, now...and for years to come. Hear it at your dealer...then tip off your friends. For literature, write...

united audio

PRODUCTS OF DISTINCTION

202-4 East 19th St., N.Y.3, N.Y.

Get This Valuable Book FREE

Just For Examining COYNE'S New Set "Applied Practical Radio-Television" on 7 DAY FREE TRIAL!

Yes, you get this big, brand new book, "150 Radio-Television Picture Patterns and Diagrams Explained", absolutely FREE! Complete 11x22" Schematic Diagrams on leading models Radio and TV Sets help cut your servicing time. Easy-to-read, large 8½x11" pages, with full instructions on how to use the diagrams. A "must" in every repair kit. You get this book as a FREE Gift for asking to see Coyne's new 7-book set, "Applied Practical Radio-Television"!

NOW! 7 BIG BOOKS IN ONE GREAT SET!

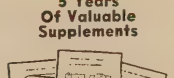
At Last! Money-Making "Know-How" On Transistors, Color TV and Servicing

Coyne's great 7-volume set gives you all the answers to servicing problems—quickly! For basic "know-how" that's easy to understand you'll find everything you want in Volumes 1 to 5 on over 5000 practical facts and data. Every step from fundamentals to installing, servicing and trouble-shooting all types of radio and TV sets. So up-to-date it includes the latest on COLOR TV and UHF. All this plus Volume 7—TRANSISTOR CIRCUITS—the most complete book ever published on the applications of transistors in electronics. *New!* Set has colorful design, washable covers.

EXTRA! 868-Page TV Cyclopedia Included!

For speedy on-the-job use, you also get Vol. 6—famous Coyne CYCLOPEDIA. Answers problems on servicing, alignment, installation, etc. in easy ABC order. Use this 7-volume TV-RADIO LIBRARY FREE for 7 days; get the Servicing Book FREE!

FREE! 5 Years Of Valuable Supplements



With your set you also get Coyne's annual Supplement Service FREE for 5 years. Keeps your set up-to-date on everything that will be new in radio, television, electronics and electricity.

SEND NO MONEY! Just mail coupon for 7-volume set on 7 days free trial. We'll include book of 150 TV-Radio Patterns & Diagrams. If you keep the set, pay $3 in 7 days and $3 per month until $27.25 plus postage is paid. (Cash price, only $24.95). Or you can return the library at our expense in 7 days and owe nothing. YOU BE THE JUDGE. *Either way, the book of TV-Radio Patterns is yours FREE to keep!* Offer is limited. Act NOW!

FREE BOOK—FREE TRIAL COUPON!

Educational Book Publishing Division
COYNE ELECTRICAL SCHOOL, Dept. 10-T1
1501 W. Congress Pkwy., Chicago 7, Ill.

YES! Send 7-Volume "Applied Practical Radio-Television" for 7 days FREE TRIAL per your offer. Include TV-Radio Patterns & Diagram Book FREE.

Name ..... Age .....

Address .....

City ..... Zone..... State.....

Where Employed .....

☐ Check here if you want library sent C.O.D. You pay postman $24.95 plus C.O.D. postage on delivery. 7-day money-back guarantee.

Educational Book Publishing Division
COYNE ELECTRICAL SCHOOL
1501 W. Congress Pkwy., Dept. 10-T1, Chicago 7, Ill.

This book is a GOLD MINE Send for it... immediately!

Reveals how you can gain quicker success and assure a well-paid career in . . .

ELECTRONICS

QUALIFY FOR A SECURE CAREER, NOT JUST ANOTHER JOB.

It's the "Age of Electronics!" Men with *advanced* technological knowledge are in crucial demand. But there's no place for the mediocre man. Why take chances with your future? Why not begin now to qualify for an *important* position next year—or even sooner?

ELECTRONICS HAS GOOD PAYING JOBS FOR QUALIFIED MEN!

And only qualified men can fill them. You can get your share, if you take time now to gain indispensable advanced electronics knowledge.

"Many of the men currently on the street are there for a reason. As many as 8 out of 10 are deadwood," estimates the chief engineer of a medium-sized Philadelphia firm; "the problem is to find the live ones."

— From ELECTRONICS MAGAZINE

If you're interested in an honest-to-goodness career in the vigorous electronics industry, here's how you can step ahead of job-competition, move up to a better job, earn more money, AND BE SURE OF HOLDING YOUR TECHNICAL JOB, EVEN WHEN THE "DEADWOOD" IS BEING CLEANED OUT. Sure you have some experience. But the fellows with only partial electronics knowledge move slowly, or stand still while you —the man with advanced technical education— plunge ahead in the golden world of electronic opportunities.

BRAND NEW COURSE ADDED — AUTOMATION AND INDUSTRIAL ELECTRONIC ENGINEERING TECHNOLOGY

A complete home study course covering all electronic phases of automation with special emphasis on the theory, functioning, and applications of servomechanisms and computers. Also noteworthy are the lessons on machine control, instrumentation, data-processing, and telemetry.

FILL OUT AND MAIL POSTAGE FREE CARD FOR FREE 54 - PAGE BOOK...

Z-3

Let us show you how *advanced* education via CREI leads to a bright career in . . .

ELECTRONICS—AUTOMATION—INSTRUMENTATION—INDUSTRIAL ELECTRONICS—AERONAUTICAL ELECTRONICS—GUIDED MISSILES—SERVOMECHANISMS—COMPUTERS—ASTRONAUTICS—TELEMETERING—COMMUNICATIONS—MANUFACTURING

Study at Home for a career in ELECTRONICS

ACQUIRE NECESSARY TECHNICAL KNOWLEDGE AT HOME

Use spare-time hours for CREI Home Study, as thousands of successful men have done since 1927. Get concentrated education in minimum time, then step into a good position and enjoy excellent pay in the solidly-growing electronics industry. CREI courses are being studied today on the DEW Line in the Arctic—in Alamagordo and in Munich—by electronics experts in guided missile development and by telemetering technicians on the missile ranges.

CREI PREPARES YOU IN MINIMUM TIME AT HOME

Thousands of men *before* you have benefited quickly from CREI Home Study. Thousands of CREI graduates are *now employed* in industry here and abroad. Here is what one graduate has to say:

"In the time of less than two years, I have almost doubled my salary and have gone from wire-man to engineering assistant and now to junior engineer. I have CREI to thank."

Frank A. Eckert,
22 Clover Lane
Levittown, Pa.

CREI OFFERS RESIDENCE COURSES at the same high technical level. Day and evening classes start at regular intervals. Qualified residence school graduates earn degree as "Associate in Applied Science" in 27 months.

If you have had electronic education, or experience in electronics—and realize the need of a high-level technical knowledge to make good in the better electronic jobs—you can qualify for CREI home study education. (Electronic experience is not required for admission to CREI Residence School.) Check card if you prefer residence or home study information . . . or write, Capitol Radio Engineering Institute, Dept. 1401-G, 3224 16th St., N.W., Washington 10, D. C.

Available to veterans under GI Bill.

CREI prepares you quickly for success . . . in advanced Electronic Engineering Technology, including Servomechanisms; Computers; Radar; Automation; Aeronautical Electronics; Broadcasting; Communications and Manufacturing; and the Electronic principles associated with guided missiles, telemetering, astronautics and instrumentation.

BENEFITS FELT RIGHT AWAY

Almost immediately, you feel the benefits of CREI study. Your employer, when informed (only at your request) of your step toward advancement, is certain to take new interest in you and in your future. What you learn in CREI Home Study can start helping you do a better job almost from the first lesson.

CREI HOME STUDY . . . QUICK WAY TO BOOST YOUR EARNINGS

Since 1927, CREI has given thousands of ambitious young men the technical knowledge that leads to better positions—better pay—greater security—promotions—better living for yourself and your family. CREI can help you, too—if you really want to be helped. CREI lessons are prepared by experts in easy-to-understand form. There is a course of instruction geared to the field in which you want to specialize. Study at your convenience, at your rate of speed.

INDUSTRY RECOGNIZES CREI EDUCATION

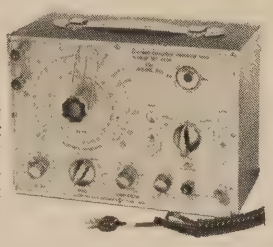
CREI courses are prepared with an eye to the needs and demands of industry, so your CREI diploma can open many doors for you. Countless CREI graduates now enjoy important, good-paying positions with America's most important companies. Many famous organizations have arranged CREI group training for their personnel. To name a few: All America Cables and Radio, Inc.; Columbia Broadcasting System; Gates Radio Company; Federal Electric Corp.; The Martin Company; U. S. Information Agency (Voice of America); Trans-Canada Air Lines; United Air-Lines. You can follow the choice of these great corporations with confidence.

PAYS FOR ITSELF QUICKLY

Your very first raise could repay your investment in CREI education, and leave you a profit the very first year. Increases in pay thereafter are pure profit, and you'll be prepared for many more promotions and pay raises in the future.

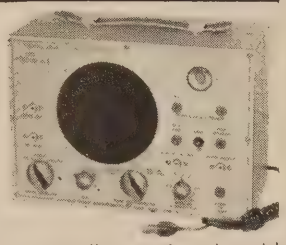
EMC advances in Audio and Test Equipment — by far the Best Values obtainable in Wired or Kit form.

EMC Model 801 RC Bridge and In-Circuit Capacity Checker



A new comprehensive resistance and capacity checker. It measures condensers for actual value, leakage, and power factor. In addition it measures condensers while still connected in their original circuits for opens, shorts or intermittents.
Model 801 Wired .....$38.95 — Model 801 Kit $24.95

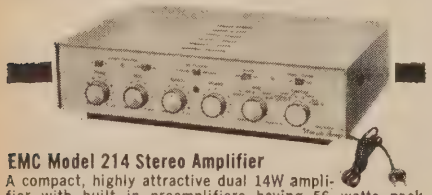
EMC Model 802 Signal Tracer and Generator



Generates its own audio, IF and RF signal for tracing. Uses both a magic eye tube and a speaker for signal detection. Checks noisy components. Checks and compares magnetic, ceramic and crystal cartridges. Supplied with two shielded audio probes and RF crystal demodulator probe. **Model 802 Wired $38.95**
Model 802 Kit $24.95

EMC Model 107A Peak to Peak Vacuum Tube Volt-Ohm Capacity Meter

6" meter cannot burn out — entirely electronic, Measures peak to peak AC voltages to 2800 volts in 6 ranges. Measures capacity in 6 ranges from 50 mmfd to 5000 mfd. Measures resistance in 6 ranges from .2 ohm to 1000 megs. Measures DC volts to 1000 volts in 6 ranges. Input resistance 16.5 megs.
Model 107A Wired ....$51.40 — Model 107A Kit $36.50



EMC Model 214 Stereo Amplifier

A compact, highly attractive dual 14W amplifier with built in preamplifiers having 56 watts peak power output. Has rumble filter and contour control switch. Extremely low distortion and noise level. It can be used as a 28 watts (56 watts peak) monaural amplifier or as a monaural amplifier so arranged that one preamplifier is used to drive the internal amplifier while the other preamplifier is used to drive any existing monaural amplifier.
Model 214 Wired .....$106.80 — Model 214 Kit $68.90

RE16

Yes, tell me more, send me **FREE** a detailed catalog of **the Complete EMC Line.**

NAME .....

STREET .....

CITY ..... STATE.....

EMC Electronic Measurements Corp.
625 B'way, New York 12, N. Y.
Ex. Dept. 370 Broadway, New York 13, N. Y.

ELECTRONICS

(*Continued from page* 99)

individual 365-$\mu\mu$f miniature units (such as Argonne AR-274). Place them side by side and glue them together. Now attach a tiny pulley to each shaft and string them together with dial cord. Make the cord tight to prevent slippage. Now cut one shaft short and put the knob on the other (Fig. 3). The one knob will control both units and you will have a very small dual 365-$\mu\mu$f variable.

Heat sinks

To get maximum efficiency from heat sinks used for power transistors, paint them dull black. Black is a much better radiator of heat, so that a small black heat sink might be much better than a larger shiny one. You can also use this principle for ordinary transistors. If a transistor is going to be near something warm, paint it with a shiny aluminum paint. If you are worried about the transistor itself heating, paint it dull black so it can easily radiate its excess heat.

Color-code transistors

After a time, the experimenters build up a supply of transistors. A handy way to identify them quickly would be to color-code them in a manner similar to the resistor color code. The first two (or three) numbers could show the transistor's beta or current gain. The next band could be gold or silver for n-p-n and p-n-p, respectively. You could use another notation for function, so you could easily spot an audio, rf or any other kind of unit. About 10 colors of 10-cent bottles of paint such as Testor's Pla (available at a hobby store) will code hundreds of transistors for rapid identification.

Holding thin wires

Sometimes it is difficult to hold very thin wires in ordinary alligator clips, since the wire slips through the teeth. The problem can be easily remedied by filing off the teeth. Now the jaws will be flush and the tiny wire will be gripped easily, putting an end to the slipping. END

FCC WANTS ENGINEERS

Engineering positions with the Federal Communications Commission are being added at many of the 31 field offices and 18 monitoring stations scattered throughout the country, in Washington, Alaska, Hawaii and Puerto Rico. Young engineering seniors, graduates and men with some electronics experience in general are eligible for the positions. They are all Civil Service and carry starting salaries from $4,490 to $5,880 and up, depending on experience and education.

For more information, write to the Federal Communications Commission, Washington 25, D. C.

No Risk Trial Guarantees you can

FIX ANY TV FAST!

. . . or pay not one cent!

NO EXPERIENCE OR HIGHER MATH NECESSARY

Let 10 days' use of this book prove you can install and repair any TV set like an expert. You'll be amazed how easy it is to spot most troubles by eye and ear alone—how the clear, step-by-step instructions and illustrations reduce even the most complicated problems to simple a-b-c's. Quickly and easily, with this manual to guide you, you can turn your up-to-the-minute knowledge into plenty of spare-time cash or be your own boss in a profitable business.

All New! 3rd Revised Edition

TRANSISTORIZED TV
COLOR SETS
PRINTED CIRCUITS
DEFLECTION METHODS
DC RESTORATION
ANTENNAS
POWER SUPPLIES
SYNCHRONIZATION

In this new edition you get: The latest circuits—Trouble-shooting techniques—Transistorized TV sets—Remote control tuning—Troubleshooting printed wiring—Module type construction—Packaged circuits—Newest servicing hints—Latest information on color TV and test equipment . . . every new advancement **plus** the basic know-how you need to put any set back in perfect working order.

Mr. C. W. Morris of Charleston, W.Va., says: "I have paid as much at $200.00 for courses that haven't given me the clear understanding this book has."

TRIAL COUPON—MAIL TODAY

PRENTICE-HALL, INC., Dept. 5744-AI
Englewood Cliffs, New Jersey

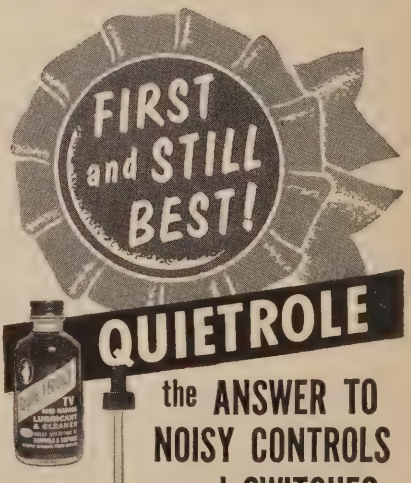
Please send me TELEVISION SERVICING for which I enclose $2.75 (plus postage) as first payment. Then after I have used the book for 10 days, if I am not satisfied I may return it and get immediate REFUND of my first payment. Or I will keep the book and send you two more payments of $2 a month for 2 months until full price of $6.75 is paid.

Name .....

Address .....

City ..... Zone..... State.....

SAVE! Send $6.75 now and we'll pay postage. Refund and same return privilege guaranteed.

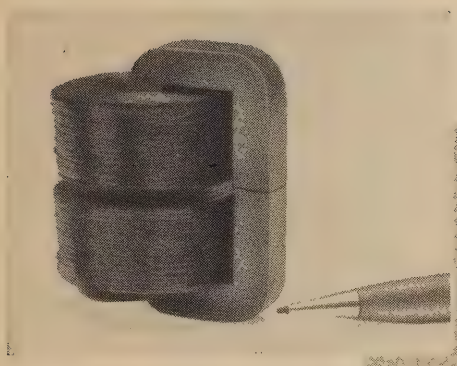


the ANSWER TO NOISY CONTROLS and SWITCHES over 12 YEARS OF PROVEN SUPERIORTY

Costs Just Pennies more than the poorest substitute . . .

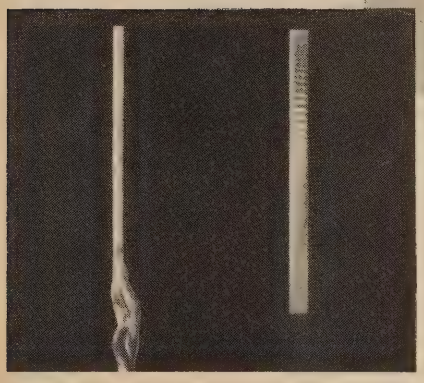
Supplied in Spray can and 2, 4, 8 oz. bottles

MFG BY **QUIETROLE COMPANY**
SPARTANBURG, South Carolina



The Hall-effect device, a known possibility since 1879, is now a reality

Something NEW in SEMICONDUCTORS



By R. WAYNE CRAWFORD and NEAL P. MILLIGAN*

IN 1879, E. H. Hall, a physicist at Harvard University, discovered an effect which has become known as the Hall effect and today is the basis for a new series of semiconductor devices. Hall determined that, when a conductor through which current is flowing is placed in a magnetic field perpendicular to the conductor, a voltage is developed across it.

For a clearer picture of this action, take a look at Fig. 1. When there is no magnetic field, the electrons flow through the conducting slab in a straight line (labeled control current) and there is no voltage difference across the slab. If a magnetic field is applied, the electrons are deflected toward the side as shown, leaving a surplus of positive charges on the opposite side of the slab. This creates a voltage difference across the slab, known as the Hall voltage. This voltage is proportional to the product of the current passing through the conductor and the magnetic flux density (magnetic lines per unit area). The magnitude of the Hall voltage for a given current and magnetic field depends on the ease with which electrons can move through the material, so the ease of movement becomes a figure of merit for the material and is called "charge-carrier mobility." The higher the charge-carrier mobility, the higher the Hall voltage for a given magnetic field and control current.

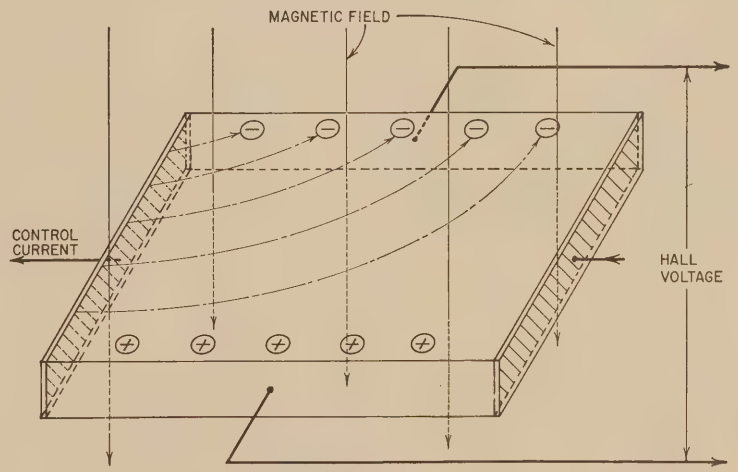


Fig. 1—Basic action of a Hall-effect device. The electrons supplied by the control circuit are deflected by the magnetic field to one side of the conducting slab. This leaves an excess of positive charges on the opposite side, thereby causing a voltage known as the Hall voltage, across the slab.

Until recently, no known material had a charge-carrier mobility high enough to allow Hall voltages great enough to be of practical use. But the development of intermetallic compounds —indium arsenide and indium antimonide—has made Hall-effect devices practical. Such Hall-effect devices are now commercially available.

For most applications, a magnetic circuit produces the magnetic field needed to operate the Hall-effect device. A sketch of such a circuit is shown in Fig. 2. The input currents passing through the coils create a magnetic field. As many coils as the physical configuration of the core will allow can be used. The top head photo shows a typical magnetic circuit using two

*Technical consultant, and manager of Applications Div., respectively, Ohio Semiconductors.

What the DUAL-1006 *combination turntable/changer won't do*

won't wear records* — because the tonearm is totally disengaged from the cycling mechanism during play . . . automatically . . . and tracks perfectly at as low as 1½ grams stylus pressure.

DUAL-1006

won't produce rumble or hum* — because totally shielded motor is 100% balanced in both axes, and rigid-equipoise motor suspension prevents noise at the source.

DUAL-1006

won't develop flat-spot idler thump — because all gears and idler disengage automatically after play — no neutral position to worry about.

DUAL-1006

won't wow or flutter* — because heavy armor-gauge turntable is both laminated and concentrically girded to prevent warping and eccentricity.

DUAL-1006

won't chip record edges or enlarge center holes — because Elevator Action changer-spindle uses no pusher arm, no offsets; lifts stack off bottom record before it descends.

DUAL-1006

won't ever become obsolete — because any present (or future) size records from 5″ to over 12″ can be intermixed, and in any sequence.

DUAL-1006

won't disappoint you — because these are just a few of its wonderful features that result in flawless, reliable performance. See your dealer soon, or write us for the full story.

united audio

PRODUCTS OF DISTINCTION

202-4 East 19th St., N.Y.3, N.Y.

****Comparable to professional equipment, and so vital for stereo reproduction.***

center-tapped coils. The total magnetic field is equal to the sum of the magnetic fields generated by each coil. To reduce the number of coil turns needed to produce a given magnetic field, the gap in the core is made very small. The gap can be made small since the Hall-effect device is very thin, as shown in the bottom head photo.

The Hall-effect device is truly a low-level device in all respects. The maximum control current, when operated in free air, is approximately 500 ma.

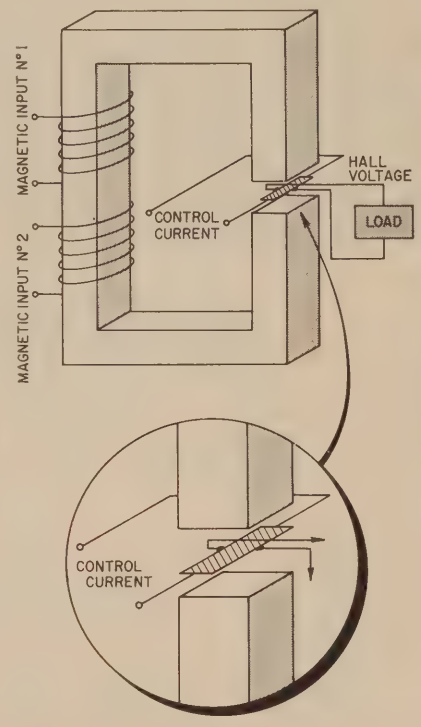


Fig. 2—Typical 2-coil magnetic circuit. The iron core concentrates the magnetic field on the Hall-effect device.

The output Hall voltage is in the order of hundreds of millivolts. The input and output impedances are on the order of 1 ohm. To obtain such low-level impedances with vacuum tubes or transistors requires complex circuits. The Hall-effect device is filling a real need in the electronics field by providing a low-impedance circuit element. It also has the property of being able to function equally well with either dc or ac inputs.

A typical Hall-effect device multiplying circuit is shown in Fig. 3. The magnetic field generated by the coil is proportional to the current flowing in the coil. The output voltage is, therefore, proportional to the product of the magnetic circuit current and the control current. If more than one coil is used in the magnetic circuit and if the control current is held constant, the output voltage is proportional to the sum or difference (depending upon their relative polarity) of the input currents. By appropriate switching, a single Hall-effect device and magnetic circuit can perform all of these functions.

PROFESSIONAL technicians use *Dave Rice's* OFFICIAL ORDER BOOKS for every TV-RADIO service call

This is the businesslike approach to service record keeping. Triplicate forms serve as order form, invoice and office record, with spaces for complete information on every job. Separate listings for receiving tubes, pix tube, parts, serial numbers, labor and tax charges, signatures, etc. 75c a book, $6.50 for dust-proof box of 10. In stock at your distributor.

Write for your *free* folder describing Dave Rice's OFFICIAL ORDER BOOKS, including an actual size sample copy of the handy order form.

* * *

For customer's prices on every replacement part, plus flat rate and hourly service charge data, regional and national, Dave Rice's OFFICIAL PRICING DIGEST, listing over 63,000 items. $2.50.

ELECTRONIC PUBLISHING CO., INC.
180 N. WACKER DRIVE
CHICAGO 6, ILLINOIS

It's Easy to Install This

CITIZENS BAND 27 MC ANTENNA

DESIGN permits rapid mounting similar to that used for TV antennas—on 1¼″ masting, tubing, chimney mounts, sidewall brackets, etc.

PROVEN PERFORMANCE: Full half-wave coaxial type widely used in communications. Maximum performance by resonating to operating frequency. Eliminates uncertainty of flexible wire ground plane systems. And requires no loading coils!

FINEST CONSTRUCTION: All aluminum seamless tubing, with weatherproof UHF coaxial connector. Aluminum casting main support. Weighs only 2 lbs., 14 oz. Overall height a full 17′ 6″.

MODEL CO-27 ★ PRICE ONLY $14.95

Free literature from

HI-PAR PRODUCTS CO.
B88, FITCHBURG, MASS.

ELECTRONICS

The Hall-effect devices described here are new, even though the principle has been known many years. They have been manufactured in the United States less than a year. As were the first transistors, Hall-effect devices are relatively expensive today—about $25 each

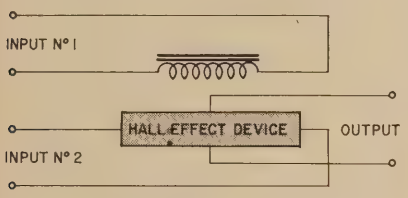


Fig. 3—An electronic multiplier circuit. The output voltage is proportional to the product of the two inputs.

in lots of one. However, it is reasonable to assume that as with transistors, their cost will drop in a short time.

The potential applications of these devices are almost limitless. They may be used in computer circuits to add, subtract and multiply. With an amplifier, they have been used to measure the earth's magnetic field. They are being used in both ac and dc power meters. They may be used to match a high impedance to a low impedance and provide isolation at the same time. These devices and the associated magnetic circuit may be considered as a dc transformer, since they provide transformer action even with direct currents.

These new semiconductor devices present an entirely new concept in the field of circuitry and will play an important role in the design of new electronic equipment. END

50 Years Ago

In Gernsback Publications

HUGO GERNSBACK, *Founder*

Modern Electrics	1908
Wireless Association of America	1908
Electrical Experimenter	1913
Radio News	1919
Science & Invention	1920
Television	1927
Radio-Craft	1929
Short-Wave Craft	1930
Television News	1931

Some larger libraries still have copies of Modern Electrics on file for interested readers.

In January, 1910, *Modern Electrics*

Dr. Korn's Apparatus, by A. C. Marlowe.
A Muffled Spark Gap, by H. W. Secor.
New Tuning Arrangement.
Metropolitan Tower Radiophone.
Construction of a Hot Wire Ammeter.
Construction of a Sending Condenser, by Frederick Re Qua.
How to Make An Improved Silicon Detector, by Charles W. Gale.
How to Make A Universal Detector, by E. R. Willard.
New (French) Loud Speaking Telephone.

The Very Best Now Costs You Less

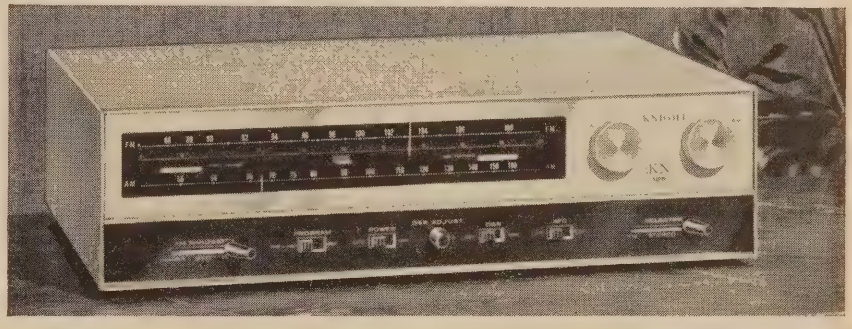
KNIGHT® STEREO HI-FI
A PRODUCT OF ALLIED RADIO

. . . challenges comparison with the costliest components . . prove it for yourself on our 15-day free home trial . . doubly guaranteed: specifications meet or exceed published figures or we refund your money . . unconditionally guaranteed for one full year . . .

KN 760

deluxe 60-watt complete stereo amplifier

Fifteen stereophonic and monophonic controls • 60 watts rated stereo output . . . 76 watts usable . . . 152 watts peak-to-peak • ± 0.5 db, 25-20,000 cps • Third channel speaker output with new additive full-range circuit • 5 pairs of stereo inputs . . . including auxiliary for new cartridge tape playback • Long-life silicon diode heat-free power supply with oversize transformer • Humless DC on all preamp tubes • Vinyl-clad metal case included in price • Anodized front panel in brushed gold and charcoal brown • Shpg. wt., 35 lbs. . . . *only* **$149.95.** *$5.00 down.*



KN 125

deluxe stereo FM-AM tuner

Separate FM and AM sections for stereo reception • Adjustable DSR corrective feedback for lowest distortion of FM • Front panel audio and a.c. switching for multiplex • Dual limiters on FM • Tuned RF stage on both FM and AM • 2.5 microvolt sensitivity on FM • ± 0.5 db, 20-20,000 cps • Cathode follower multiplex and tape output jacks • Dual "Microbeam" tuning indicators • Illuminated 9½" tuning scale • Low-noise 50-ohm extra antenna terminals • Solid aluminum front panel, gold anodized, with vinyl-clad case. Shpg. wt., 21 lbs. . . . *only* **$139.95.** *$5.00 down.*

order from

ALLIED RADIO

New Easy Terms:
Only $5 down (or less) on orders up to $200. Up to 24 months to pay.

FREE 1960 ALLIED CATALOG

Send for your complete, money-saving guide to the world's largest selection of hi-fi components and systems. See everything in stereo; all the new KNIGHT components; all leading make lines. For everything in hi-fi, for everything in Electronics, get the 1960 ALLIED Catalog. FREE—write for it today.

ALLIED RADIO, Dept. 31-A
100 N. Western Ave., Chicago 80, Ill.

Ship the following Knight components:

☐ KN-760. ☐ KN-125. $_____ enclosed (I understand your 15-day trial and money-back guarantee applies to this purchase.)

☐ Send FREE 1960 ALLIED Catalog

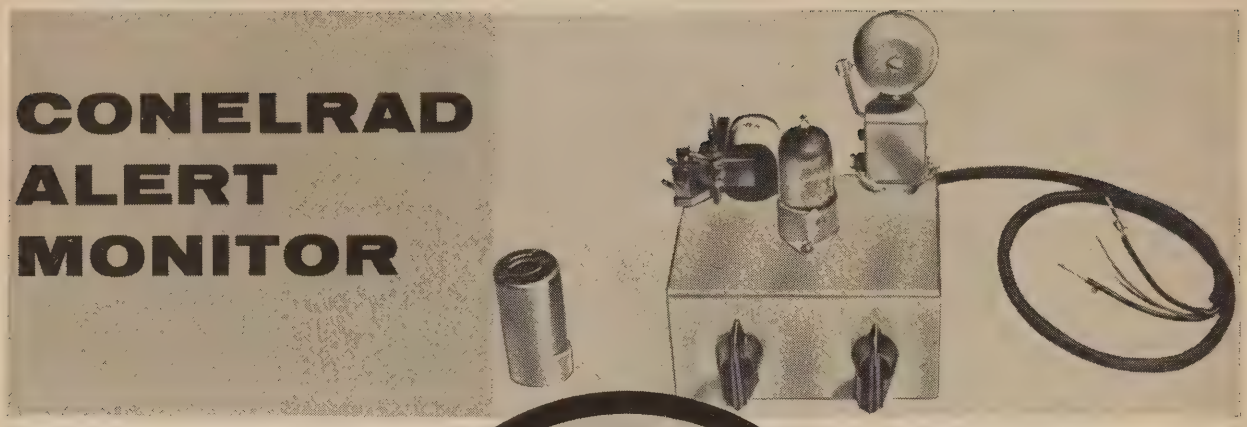
Name_____

Address_____

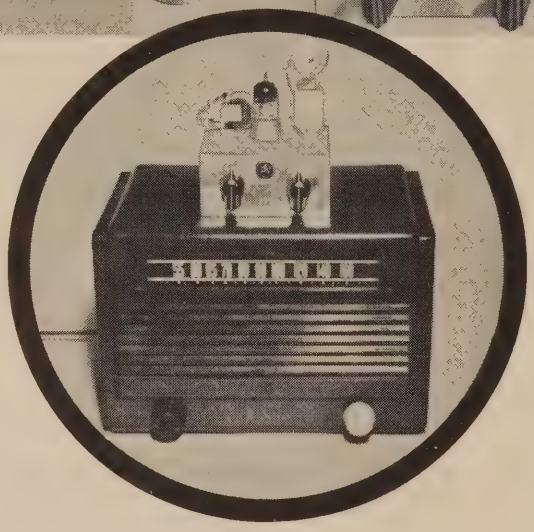
City_____ Zone_____ State_____

CONELRAD ALERT MONITOR

Automatic alarm circuit warns of a Conelrad alert



(Above) Completed alarm unit. This model did not have a pilot-light indicator.



(Left) One method of attaching unit to a broadcast receiver.

By HAROLD REED

IN the interest of civilian defense, the Conelrad plan was put into operation. Conelrad is a contraction of *con*trol of *el*ectromagnetic *rad*iation. Conelrad's purpose is to prevent enemy aircraft pilots from using the radiation of any AM, FM, TV or amateur US broadcasting station as a navigational guide and riding in on its beam to desired targets.

Certain AM stations in each area have been designated key stations. Any Air Defense Control Center can initiate a Conelrad radio alert by notifying these basic-key, relay-key and skywave-key stations by private wire or toll telephone. The key stations immediately start the following procedure:

1. Cut the program being broadcast.
2. Cut the carrier for 5 seconds.
3. Restore the carrier for 5 seconds.
4. Cut the carrier for 5 seconds.
5. Restore the carrier again.
6. Radiate a 1,000-cycle tone for 15 seconds.
7. Broadcast the Conelrad radio alert message: "We interrupt our normal program to cooperate in security and civil defense measures as requested by the United States Government. This is a Conelrad radio alert. Normal broadcasting will now be discontinued for an indefinite period. Civil defense information will be broadcast in most areas at 640 or 1240 on your regular radio receiver."
8. Remove the carrier (at the normally assigned frequency) from the air for the duration of the alert.

Authorized AM stations then operate in a sequential manner on 640 and 1240 kc, broadcasting civil defense information without aiding enemy aircraft. All other AM, FM and TV stations are required to follow steps 1–8 and leave the air for the duration of the alert.

The Conelrad plan is incorporated into FCC rules and regulations. Under these rules it is mandatory for all stations to install and maintain equipment to receive notice of radio alerts and radio all-clears. Automatic devices or a human listening watch may be used. Stations must also monitor a key station before going on the air to insure that a radio alert is not in progress.

It is disconcerting to monitor a program being radiated from any particular transmitter and the signal of another station simultaneously. Distraction from the program which a transmitter technician is radiating also results under these conditions. A number of automatic alarm circuits have been devised, some complex and costly. However, simple and inexpensive circuits can be used satisfactorily.

Simple alarm circuit

Inexpensive receivers are usually satisfactory for monitoring a key station and actuating an alarm device. Of course, if the nearest key station is a considerable distance from the monitoring point and the signal received is weak and subject to fading, a more sensitive and selective type of receiver is required.

In the circuit of Fig. 1, a negative voltage from the receiver's avc is fed to the grids of the 12AT7. The potentiometer is adjusted so that current flow through the tube is not enough to trigger the plate-circuit relay. Under these conditions the relay contacts complete the 6-volt ac circuit to the pilot light, indicating that the device is in operating condition. The receiver's volume is reduced so the program from the monitored station is not audible. If the carrier of the monitored station is interrupted, the avc voltage drops to zero and the negative voltage on the control tube's grid is removed. Increased current flows through the 12AT7, actuating the relay. The pilot light

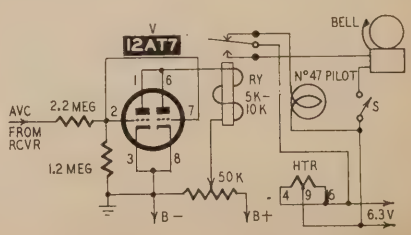
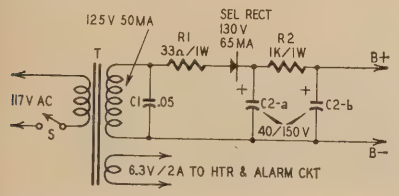


Fig. 1—Basic alarm circuit.

goes out and the 6-volt ac supply circuit to the bell or buzzer alarm is completed. The receiver's volume is then adjusted so the monitored key station can be heard. The switch is opened to turn off the alarm. This circuit has given satisfactory service. It features simplicity and a minimum of parts.



R1—33 ohms, 1 watt
R2—1,000 ohms, 1 watt
C1—.05 μf, 600 volts
C2—40-40 μf, 150 volts, electrolytic
RECT—selenium, 130 volts, 65 ma
S—spst toggle, can use receiver power switch
T—Power transformer: primary, 117 volts; secondary, 125 volts, 50 ma; 6.3 volts, 2 amps (Stancor PS-8421 or equivalent)

Fig. 2—Power supply for the monitor.

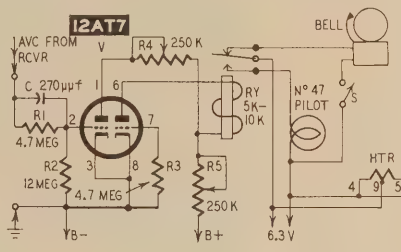
Originally, supply voltage for the control tube was taken from the receiver. However, should the receiver fail due to a bad tube or other component, the control tube could not operate to give the alarm. Receiver failure would be unknown until the next routine check. To overcome this undesirable condition, a simple selenium-rectifier supply (see Fig. 2) was provided. The 6-volt heater transformer for this tube can also operate the alarm device.

The monitor should only be used with ac receivers, or lethal potentialities may develop. If it becomes necessary to use it with an ac-dc set, the monitor's ground circuit must be isolated from its chassis and the monitor kept on a shelf in some hard-to-reach place. With an ac-dc receiver one side of the line would be connected to the monitor's ground circuit. As this is a fixed installation, the lines can be permanently wired or polarized plugs used.

Control-circuit failure

Although the problem of receiver failure is overcome, there still is the disadvantage of having no indication of failure in the control circuit or control tube itself. An arrangement that will sound the alarm, not only when the carrier of the monitored station is interrupted, but when any interruption or failure occurs in the receiver or control circuit, is shown in Fig. 3. The mechanical spring action of the relay sets off the alarm if any part fails. Avc voltage from the receiver is supplied to the grid of the first section of the 12AT7 twin triode, causing its plate current to drop. This results in an increased current flow through the second section of the tube due to the common load (R5) in the plate circuit. The relay closes, lighting the pilot lamp. Station carrier interruption or circuit failure in the receiver or control-tube circuits removes the negative voltage to the first grid, current flow in the second section of the tube decreases and the relay opens, completing the alarm circuit.

The circuit's control settings vary with each installation, depending on the carrier strength of the desired signal, the receiver avc voltage and the sensitivity and adjustments of the relay. With a table model receiver, we found that an 8,000-ohm relay would close with 2.5 volts of avc, which resulted in a plate current of 3 ma. With 8 volts of avc, the plate current increased to 5 ma. This was for reception of local stations and using the built-in loop antenna. In some locations an outside antenna may be necessary to provide sufficient signal strength for the receiver input. Other tubes, of course, can be used. 12AX7 and 12AU7 types worked satisfactorily. The 12AT7 gave the best results, closing the relay with less avc voltage. Also, it is a simple matter, by using a relay with additional contacts or another relay for 6-volt operation, to make and break one lead of the receiver's speaker automatically. Of course, this can be done manually with a small toggle switch.



R1, 3—4.7 megohms, ½ watt
R2—12 megohms, ½ watt
R4, 5—pot, 250,000 ohms, 2 watts
C—270 μμf
RY—plate relay, 5,000–10,000-ohm coil
S—spst toggle
V—12AT7
Pilot lamp, 6 volts (1)
Bell or buzzer, 6 volts (1)
Socket, 9-pin miniature, shielded (1)

Fig. 3—Conelrad alert monitor. Failure of alarm circuit or receiver sets off warning bell.

After the alarm is sounded, it is necessary to turn the speaker on to receive the Conelrad message. There is usually more than one key station in any area, so if the alarm should go off due to carrier interruption but the specified Conelrad procedure is not observed, it could be transmitter equipment failure and another station should be tuned in. During an alert, the speaker should be kept on to receive the all-clear message from the key station. This message is preceded by 1,000-cycle tone beeps for 15 seconds, followed by the civilian defense announcement: "Conelrad radio all-clear. Resume normal operation." The receiver could also be tuned to 640 or 1240 kc to receive civil defense information during the alert as well as the radio all-clear message.

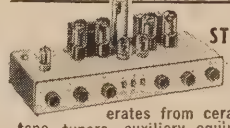
Citizens radio operators and amateurs should include this equipment. It is a simple and effective way of complying with the law that will not put them to any great expense. They will have no difficulty in making these circuits work. END

The Spotlight of Leadership is on...
AWARD WINNING
arkay
Kits and Wired
HI-FI STEREO
TODAY'S BEST QUALITY BUY

the Arkay/Harting MS-5
STEREO Record Playback TAPE DECK
Precision-engineered to the highest professional standards . . . a new achievement in tape deck design and performance. . . . Hailed by audio engineers and music lovers alike for its surpassing performance, simplicity of design and operation.
FEATURES: Combination head (mu-metal shielded) for 2 or 4 track stereo at both 3¾ and 7½ IPS • All-metal tape fingers—no cushions to wear out tape • All-metal tape guards for vertical tape control • Double shoe brakes for positive non-slip stops—minimizes tape stretch • Simple, positive-acting 5-button operation, drop-in loading • Large (4½" diam.) capstan insures constant tape speed—virtually eliminates wow, flutter, distortion • Automatic interlock prevents accidental erasure • Ultra-narrow (1.2-microns wide) gap heads assure maximum fidelity during record and playback.
SPECIFICATIONS: Record and playback frequency response: 7½ IPS, 30-16,000 cycles±2 db. Signal-to-noise ratio: better than −55 db. Flutter and wow: at 7½ IPS, ¼ of 1%; at 3¾ IPS, ⅓ of 1%. Rewind time: 110 seconds for 1200 feet. Size: 12-3/16" x 14½" x 6¼" deep.
2 Track Only $129.95 • 4 Track Slightly Higher

NEW! MUSIC MASTERPIECE

ARKAY CS-28
STEREO AMP/PRE-AMP
COMPLETE CONTROL CENTER
Full 28 watts stereo or monaural, 60 watts peak • 14 watts each channel • reverse stereo • balance control • two-channel gain control • full range bass and treble controls • IM distortion, 4 to 1 • harmonic distortion, 1% 30-20,000 cps • dual pre-amp 2V output jacks • speaker outputs, 4, 8, 16, 32 ohms • response, 20-20,000 cps • push-pull EL84 Williamson circuit • beauty of design that won Fashion Foundation's coveted Gold Medal! Many other incomparable features.
Wired and tested $99.95 Easy-to-build Kit $64.95



ARKAY CS-12
STEREO AMP/PRE-AMP
12 watts of clean power with dual inputs and outputs for excellent stereo reproduction • operates from ceramic or crystal cartridge, tape, tuners, auxiliary equipment • push-pull outputs for each channel.
Easy-to-build Kit $36.95

ARKAY ST-11 AM-FM
STEREO TUNER
Here, for the first time, is an AM-FM STEREO Tuner within the reach of every audiophile. Unmatched by units costing twice the price, the ST-11 is two distinct receivers in one featuring 4 μV. for 20 db quieting. Variable AFC. Single front panel switch controls AM, FM or STEREO selection.
Wired and tested $74.50 Easy-to-build Kit $49.95

SPA-55 STEREO AMP 55 watts stereo-monaural. 27½ watts each channel. Wired $79.95 Kit $64.95

See and hear ARKAY Kits at your dealer.
FREE! Stereo booklet and catalog. Write Dept. RE
All prices 5% higher west of Mississippi
arkay
88-06 Van Wyck Expressway Richmond Hill 18, N.Y.

COVER FEATURE

Building Your Own CITIZENS RADIO

By assembling a Citizens-band transceiver kit you can learn a lot about Citizens radio circuits and how to repair them

By LEO G. SANDS

THE easiest way to become familiar with any new device—hi-fi, telescope, oscilloscope or Citizens radio—is to build one. Those who plan to service Citizens radios, in particular, should build one because there is no quicker or surer way to learn how they work and how to tune and repair them.

You could design your own Citizens radio, but that would be doing it the hard way. The easy way is to buy a kit—there are several on the market. The price runs from under $30 to around $100.

The kits are simple—it doesn't require previous electronics experience to build one. My eldest son, Lee, 8 years old, helped me construct mine. He is interested in Citizens radio because he has seen and heard me using it. I, as an old-timer in both mobile and amateur radio, am interested in getting even more intimately familiar with the circuits I write about. Besides, I can use Citizens radio in my business.

We picked the Heath CB-1 kit because it has a tunable receiver which will let us listen in on all 23 channels in the band. By being able to tune in all channels, we can learn a great deal about what use others are making of this new communications expressway. For the nontechnical man who wants to communicate for business purposes only, a Citizens radio with a fixed-tuned receiver would be more suitable. All he has to do to use it is turn it on and operate a push-to-talk button. The experimenter, service technician and engineer who are not confused by a tuning dial, may prefer the tunable receiver.

After we unpacked the first of the two kits, the task of installing the parts on the chassis was given to Lee. The pictorial instructions were so easy to understand that he made only one error—one tube socket was installed 180° around from the way it should have been. I did the wiring, since Lee isn't yet handy with a soldering iron. Since I wire from a schematic because of years of experience doing so, I disregarded the wonderfully explicit wiring diagrams in the kit instruction book. (Don't try it!—*Editor*)

We wired first the receiver, audio amplifier and power supply sections and then paused to test the receiver. Before inserting the power plug into the outlet, we took the precaution of measuring resistance between B-plus and the chassis so we wouldn't blow the silicon rectifiers right off. Then we checked the resistance across the power-plug prongs with the on–off switch turned on. The resistance seemed reasonable so we plugged the set in.

The receiver worked immediately. Even before we connected an antenna, we picked up signals from nearby Citizens radio stations. This set is "hot," being rated as useful on a signal as small as 1 μv at the antenna terminals. Before going further, let's take a close look at the circuitry involved so far (Fig. 1).

Jacques Saphier

Eight-year-old Lee did the mechanical assembly and his dad the wiring. The kitchen table came in handy as a workbench.

Receiver and power supply

The power supply uses two silicon diodes in a voltage-doubler circuit, and resistors and large capacitors for filtering.

The receiver section is simple. It uses a single 6AN8 whose pentode section is used as a broadly tuned rf amplifier and whose triode section is a superregenerative detector. The rf amplifier has two functions. It is a one-way street which amplifies signals picked up by the antenna and feeds them to the detector. At the same time it blocks the passage toward the antenna of rf energy generated in the detector.

Most of the receiver's gain is obtained in the detector stage. The superregenerative detector, using only a single tube, provides sensitivity almost as great as that of a multi-tube superhet. It has not been used in commercial receivers for more than three decades, except in rare instances, becauses of the danger of radiating harmful radio interference, and its inherent background noise when no signal is being received. It will demodulate both FM and AM. Because of their great sensitivity, hams have made wide use of superregenerative receivers, mainly in the 2- and 6-meter bands. They work well in the 11-meter band too, which is the 27-mc class-D Citizens band.

While not as selective as a well-designed superhet, the superregenerative receiver has many things in its favor. Self-limiting, it provides almost the same audio output on weak signals as on strong ones, eliminating the need for avc. This limiting action also makes it more immune to impulse type noise

(*Continued on page* 116)

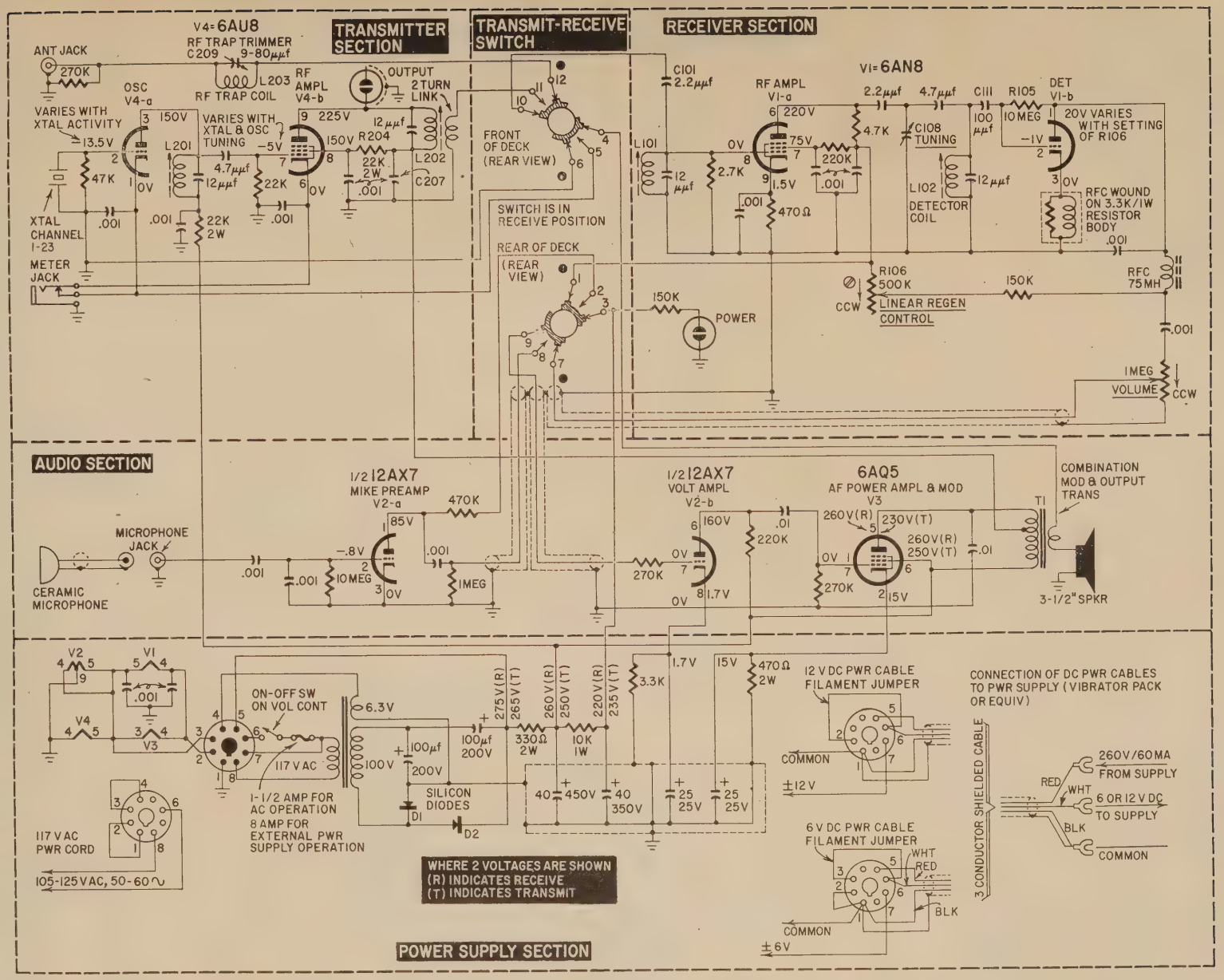


Fig. 1—Circuit of the Heathkit model CB-1 Citizens-band transceiver.

SUPERIOR'S NEW MODEL 77

VACUUM TUBE VOLTMETER

WITH NEW 6" FULL-VIEW METER

Compare it to any peak-to-peak V. T. V. M. made by any other manufacturer at any price!

- Model 77 completely wired and calibrated with accessories (including probe, test leads and portable carrying case) sells for only $42.50.
- Model 77 employs a sensitive six inch meter. Extra large meter scale enables us to print all calibrations in large easy-to-read type.
- Model 77 uses new improved SICO printed circuitry.
- Model 77 employs a 12AU7 as D.C. amplifier and two 9006's as peak-to-peak voltage rectifiers to assure maximum stability.
- Model 77 uses a selenium-rectified power supply resulting in less heat and thus reducing possibility of damage or value changes of delicate components.
- Model 77 meter is virtually burn-out proof. The sensitive 400 microampere meter is isolated from the measuring circuit by a balanced push-pull amplifier.
- Model 77 uses selected 1% zero temperature coefficient resistors as multipliers. This assures unchanging accurate readings on all ranges.

AS A DC VOLTMETER: The Model 77 is indispensable in Hi-Fi Amplifier servicing and a must for Black and White and color TV Receiver servicing where circuit loading cannot be tolerated.

AS AN AC VOLTMETER: Measures RMS values if sine wave, and peak-to-peak value if complex wave. Pedestal voltages that determine the "black" level in TV receivers are easily read.

AS AN ELECTRONIC OHMMETER: Because of its wide range of measurement leaky capacitors show up glaringly. Because of its sensitivity and low loading, intermittents are easily found, isolated and repaired.

SPECIFICATIONS

• **DC VOLTS**—0 to 3/15/75/150/300/750/1,500 volts at 11 megohms input resistance. • **AC VOLTS (RMS)** —0 to 3/15/75/150/300/750/1,500 volts. • **AC VOLTS** (Peak to Peak) —0 to 8/40/200/400/800/2,000 volts. • **ELECTRONIC OHMMETER** —0 to 1,000 ohms/10,000 ohms/100,000 ohms/1 megohm/10 megohms/100 megohms/1,000 megohms. • **DECIBELS** —10 db to + 18 db, + 10 db to + 38 db, + 30 db to + 58 db. All based on 0 db = .006 watts (6 mw) into a 500 ohm line (1.73v). • **ZERO CENTER METER**—For discriminator alignment with full scale range of 0 to 1.5/7.5/37.5/75/150/375/750 volts at 11 megohms input resistance.

Model 77 comes complete with operating instructions, probe and test leads. Use it on the bench—use it on calls. A streamlined carrying case, included at no extra charge, accommodates the tester, instruction book, probe and leads. Operates on 110-120 volt 60 cycle. Only.....

$42.50 NET

Model 77—VACUUM TUBE VOLTMETER . . . Total Price $42.50—Terms: $12.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary!

SUPERIOR'S NEW MODEL 80

20,000 OHMS PER VOLT ALLMETER

THE *ONLY* 20,000 OHMS PER VOLT V.O.M. SELLING FOR LESS THAN $50 WHICH PROVIDES *ALL* THE FOLLOWING FEATURES:

- **6 INCH FULL-VIEW METER** provides large easy-to-read calibrations. No squinting or guessing when you use Model 80.
- **MIRRORED SCALE** permits fine accurate measurements where fractional readings are important.
- **CAPACITY RANGES** permit you to accurately measure *all* condensers from .00025 MFD to 30 MFD in addition to the standard volt, current, resistance and decibel ranges.
- **HANDSOME SADDLE-STITCHED CARRYING CASE** included with Model 80 Allmeter at no extra charge enables you to use this fine instrument on outside calls as well as on the bench in your shop.

SPECIFICATIONS:

7 D.C. VOLTAGE RANGES:
(At a sensitivity of 20,000 Ohms per Volt)
0 to 15/75/150/300/750/1500/7500 Volts.

6 A.C. VOLTAGE RANGES:
(At a sensitivity of 5,000 Ohms per Volt)
0 to 15/75/150/300/750/1500 Volts.

3 RESISTANCE RANGES:
0 to 2,000/200,000 Ohms. 0-20 Megohms.

2 CAPACITY RANGES:
.00025 Mfd. to .3 Mfd., .05 Mfd. to 30 Mfd.

5 D.C. CURRENT RANGES:
0-75 Microamperes, 0 to 7.5/75/750 Milliamperes, 0 to 15 Amperes.

3 DECIBEL RANGES:
— 6 db to + 18 db
+ 14 db to + 38 db
+ 34 db to + 58 db

FEATURES:

• A built-in Isolation Transformer automatically isolates the Model 80 from the power line when capacity service is in use.

• Selected, 1% zero temperature coefficient metalized resistors are used as multipliers to assure *unchanging* accurate readings on all ranges.

Model 80 Allmeter comes complete with operating instructions, test leads and portable carrying case. Only .....

$42.50 NET

Model 80 — ALLMETER . . . Total Price $42.50—Terms: $12.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary!

NOTE: The line cord is used only for capacity measurements. Resistance ranges operate on self-contained batteries.

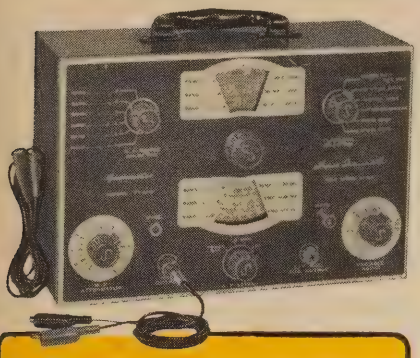
SHIPPED ON APPROVAL
NO MONEY WITH ORDER—NO C.O.D.

Try for 10 days before you buy! If completely satisfied, send down payment after trial and pay balance at indicated monthly rate — NO INTEREST OR FINANCE CHARGES ADDED. If not completely satisfied, return to us, no explanation necessary.

SEE PAGE 115 FOR COMPLETE DETAILS

MOSS ELECTRONIC, INC. 3849 TENTH AVE., NEW YORK 34, N. Y.

SUPERIOR'S NEW MODEL TV-50A



GENOMETER

7 Signal Generators in One!

- R. F. Signal Generator for A.M.
- R. F. Signal Generator for F.M.
- Audio Frequency Generator
- Bar Generator
- Cross Hatch Generator
- Color Dot Pattern Generator
- Marker Generator

Model TV-50A Genometer. Total Price—$47.50—Terms: $11.50 after 10 day trial, then $6.00 monthly for 6 months if satisfactory. Otherwise return, no explanation necessary!

A versatile all-inclusive GENERATOR which provides ALL the outputs for servicing:

A.M. Radio • F.M. Radio • Amplifiers • Black and White TV • Color TV

Specifications

R. F. SIGNAL GENERATOR: The Model TV-50A Genometer provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

CROSS HATCH GENERATOR: The Model TV-50A Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting, horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

VARIABLE AUDIO FREQUENCY GENERATOR: In addition to a fixed 400 cycle sinewave audio, the Model TV-50A Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

DOT PATTERN GENERATOR (FOR COLOR TV) Although you will be able to use most of your regular standard equipment for servicing Color TV, the one addition which is a "must" is a Dot Pattern Generator. The Dot Pattern projected on any color TV Receiver tube by the Model TV-50A will enable you to adjust for proper color convergence.

BAR GENERATOR: The Model TV-50A projects an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars.

MARKER GENERATOR: The Model TV-50A includes all the most frequently needed marker points. The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc., (3579 Kc. is the color burst frequency).

THE MODEL TV-50A comes absolutely complete with shielded leads and operating instructions.

$47.50 NET

SUPERIOR'S NEW MODEL 79 SUPER-METER — WITH NEW 6" FULL-VIEW METER

A Combination VOLT-OHM MILLIAMMETER.

Plus CAPACITY, REACTANCE, INDUCTANCE AND DECIBEL MEASUREMENTS.

Also Tests SELENIUM AND SILICON RECTIFIERS, SILICON AND GERMANIUM DIODES.

Model 79 — SUPER-METER . . . Total Price $38.50 — Terms: $8.50 after 10 day trial, then $6.00 per month for 5 months if satisfactory. Otherwise return, no explanation necessary!

The Model 79 represents 20 years of continuous experience in the design and production of SUPER-METERS, an exclusive SICO development.

In 1938 Superior Instruments Co. designed its first SUPER-METER, Model 1150. In 1940 it followed with Model 1250 and in succeeding years with others including Models 670 and 670-A. All were basically V.O.M.'s with extra services provided to meet changing requirements.

Now, Model 79, the latest SUPER-METER includes not only every circuit improvement perfected in 20 years of specialization, but in addition includes those services which are "musts" for properly servicing the ever increasing number of new components used in all phases of today's electronic production. For example with the Model 79 SUPER-METER you can measure the quality of selenium and silicon rectifiers and all types of diodes—components which have come into common use only within the past five years, and because this latest SUPER-METER necessarily required extra meter scale, SICO used its new full-view 6-inch meter.

Specifications

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500.
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000.
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes.
RESISTANCE: 0 to 1,000/100,000 Ohms. 0 to 10 Megohms.
CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd.
REACTANCE: 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms.
INDUCTANCE: .15 to 7 Henries, 7 to 7,000 Henries.
DECIBELS: −6 to +18, +14 to +38, +34 to +58.

The following components are all tested for QUALITY at appropriate test potentials. Two separate BAD-GOOD scales on the meter are used for direct readings.

All Electrolytic Condensers from 1 MFD to 1000 MFD.
All Selenium Rectifiers. **All Germanium Diodes.**
All Silicon Rectifiers. **All Silicon Diodes.**

Model 79 comes complete with operating instructions and test leads. Use it on the bench—use it on calls. A streamlined carrying case included at no extra charge accommodates the tester, instruction book and test leads.....Only

$38.50 NET

SHIPPED ON APPROVAL
NO MONEY WITH ORDER—NO C.O.D.

Try for 10 days before you buy! If completely satisfied, send down payment after trial and pay balance at indicated monthly rate — NO INTEREST OR FINANCE CHARGES ADDED. If not completely satisfied, return to us, no explanation necessary.

SEE PAGE 115 FOR COMPLETE DETAILS

MOSS ELECTRONIC, INC. 3849 TENTH AVE., NEW YORK 34, N. Y.

SUPERIOR'S NEW MODEL 82A

Multi-Socket Type TUBE TESTER

TEST ANY TUBE IN 10 SECONDS FLAT!

Model 82A—Tube Tester. Total Price $36.50
Terms: $6.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

(1) **Turn the filament selector switch to position specified.** (2) **Insert tube into a numbered socket as designated on our chart (over 600 types included).** (3) **Press down the quality button —**

THAT'S ALL! Read emission quality direct on bad-good meter scale.

Production of this Model was delayed a full year pending careful study by Superior's engineering staff of this new method of testing tubes. Don't let the low price mislead you! We claim Model 82A will outperform similar looking units which sell for much more — and as proof, we offer to ship it on our examine before you buy policy.

Primarily, the difference between the conventional tube tester and the multi-socket type is that in the latter, the use of an added number of specific sockets (for example, in Model 82A the noval is duplicated eight times) permits elimination of element switches thus reducing testing time and possibility of incorrect switch readings.

To test any tube, you simply insert it into a numbered socket as designated, turn the filament switch and press down the quality switch—THAT'S ALL! Read quality on meter. Inter-element leakage, if any, indicates automatically.

....*FEATURES*....

- **Tests over 600 tube types.**
- **Tests OZ4 and other gas-filled tubes.**
- **Employs new 4" meter with sealed air-damping chamber resulting in accurate vibrationless readings.**
- **Use of 22 sockets permits testing all popular tube types and prevents possible obsolescence.**
- **Dual Scale meter permits testing of low current tubes.**
- **7 and 9 pin straighteners mounted on panel.**
- **All sections of multi-element tubes tested simultaneously.**
- **Ultra-sensitive leakage test circuit will indicate leakage up to 5 megohms.**

***Model 82A comes housed in handsome, portable Saddle-Stitched Texon case. Only*.....** **$36.50 NET**

SUPERIOR'S NEW MODEL TW-11

STANDARD PROFESSIONAL TUBE TESTER

Model TW-11—TUBE TESTER . . . Total Price $47.50—Terms: $11.50 after 10 day trial, then $6.00 per month for 6 months if satisfactory. Otherwise return, no explanation necessary!

★ Tests all tubes, including 4, 5, 6, 7, Octal, Lock-in, Hearing Aid, Thyratron, Miniatures, Sub-miniatures, Novals, Sub-minars, Proximity fuse types, etc.

★ Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TW-11 as any of the pins may be placed in the neutral position when necessary.

★ The Model TW-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.

★ Free-moving built-in roll chart provides complete data for all tubes. All tube listings printed in large easy-to-read type.

★ NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

EXTRAORDINARY FEATURE

SEPARATE SCALE FOR LOW-CURRENT TUBES. Previously, on emission-type tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current types has been restricted to a small portion of the scale. The extra scale used here greatly simplifies testing of low-current types.

The Model TW-11 operates on 105-130 Volt 60 Cycles. Comes housed in a handsome, portable Saddle Stitched Texon case. Only..... **$47.50 NET**

SHIPPED ON APPROVAL

NO MONEY WITH ORDER—NO C.O.D.

Try for 10 days before you buy! If completely satisfied, send down payment *after* trial and pay balance at indicated monthly rate — NO INTEREST OR FINANCE CHARGES ADDED. If not completely satisfied, return to us, no explanation necessary.

SEE FOLLOWING PAGE FOR COMPLETE DETAILS

MOSS ELECTRONIC, INC. 3849 TENTH AVE., NEW YORK 34, N. Y.

SUPERIOR'S
NEW MODEL 83

C.R.T. TESTER

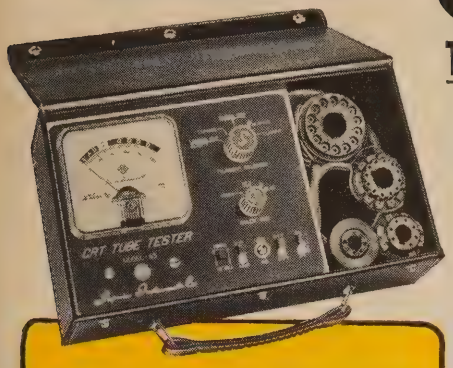
Tests and Rejuvenates ALL PICTURE TUBES

ALL BLACK AND WHITE TUBES

ALL COLOR TUBES

From 50 degree to 110 degree types—from 8" to 30" types.

Test ALL picture tubes—in the carton —out of the carton—in the set!



Model 83—C.R.T. TUBE TESTER . . . Total Price $38.50—Terms. $8.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary!

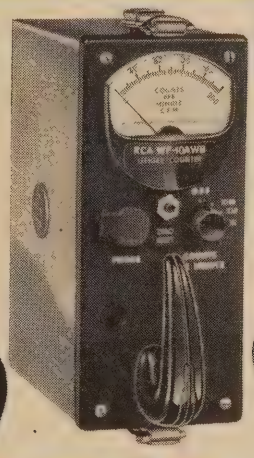
- Model 83 is *not* simply a rehashed black and white C.R.T. Tester with a color adapter added. Model 83 employs a new improved circuit designed specifically to test the older type black and white tubes, the newer type black and white tubes and all color picture tubes.
- Model 83 provides *separate* filament operating voltages for the older 6.3 types and the newer 8.4 types.
- Model 83 employs a 4" air-damped meter with quality and calibrated scales.
- Model 83 properly tests the red, green and blue sections of color tubes individually—for each section of a color tube contains its own filament, plate, grid and cathode.
- Model 83 will detect tubes which are apparently good but require rejuvenation. Such tubes will provide a picture seemingly good but lacking in proper definition, contrast and focus. To test for such malfunction, you simply press the rej. switch of Model 83. If the tube is weakening, the meter reading will indicate the condition.
- Rejuvenation of picture tubes is not simply a matter of applying a high voltage to the filament. Such voltages improperly applied can strip the cathode of the oxide coating essential for proper emission. The Model 83 applies a *selective* low voltage *uniformly* to assure increased life with no danger of cathode damage.

Model 83 comes housed in handsome portable Saddle Stitched Texon case—complete with sockets for all black and white tubes and all color tubes. Only..... **$38.50 NET**

RCA RADIATION COUNTER

Indicates Radioactivity in 3 Ways!

1—By Neon
2—By Phone
3—By Meter



RCA Radiation Counter
Total Price $47.50

Terms: $11.50 after 10 day trial, then $6.00 monthly for 6 months if satisfactory. Otherwise return, no explanation necessary.

MADE TO SELL FOR $150—OFFERED FOR ONLY $47.50

(Much less than cost of Manufacture.)

Endless experiments and discoveries in the new exciting field of nuclear energy are made possible when you acquire this finely built and engineered device. In the past, a rugged counter which was suitable for the prospecting of radioactive ores such as uranium, thorium and radium, was unsuitable for laboratory work due to the inability of combining accuracy with ruggedness. Conversely, a laboratory counter, while being extremely sensitive, could not withstand use in the field where it would be subjected to abuse and abnormally hard knocks. The Model WF-10AWB combines the laboratory and field counter in one rugged instrument. The use of phones and a visible lamp permits the operator greater freedom of operation as he no longer has to keep his eyes on a relatively small indicator.
In the laboratory where determinations of intensity (counts) of a reading are necessary, the WF-10AWB provides sensitivity far surpassing many laboratory counters.

- Employs the extra sensitive 1B85 Bismuth Type Geiger Counter tube. Sensitivity is .05 Roentgens per hour (1 MR/HR=2000 counts per minute).
- Three counting ranges: 0-100/1,000/10,000 counts per minute.
- Handy reset button.
- Ideal for survey work as the complete unit weighs only 5½ lbs.
- Sight and sound indications by neon flashes and headphone. Then when an indication is obtained you switch to meter reading for exact measurements.
- Decontamination easy with damp cloth applied to the weatherproofed aluminum case.
- A radioactive specimen is included for instrument checking and experiments.
- Included at no extra charge—U.S. Atomic Energy Commission booklet titled "Prospecting with a Counter."

SPECIFICATIONS

Three counting ranges are available
0-100 counts per minute—used in cosmic ray and extremely low activity determinations.
0-1000 counts per minute—used for average activity and normal work.
0-10,000 counts per minute—used for tracer and high activity determinations. High accuracy is assured by the handy reset button, located on the front panel, which permits compensation for variations of battery voltages and background count.
A rugged weather-proof aluminum case houses this light economical unit. The batteries will provide over 200 hours of intermittent operation from the two 67½ volt batteries and 50 hours from the three flash light batteries.

Comes with complete set of batteries, carrying strap, headphone, radioactive specimen and A.E.C. booklet. Only..... **$47.50 NET**

SHIPPED ON APPROVAL
NO MONEY WITH ORDER — NO C.O.D.

MOSS ELECTRONIC, INC.
Dept. D-705, 3849 Tenth Ave., New York 34, N. Y.

Please send me the units checked on approval. If completely satisfied I will pay on the terms specified with no interest or finance charges added. Otherwise, I will return after a 10 day trial positively cancelling all further obligation.

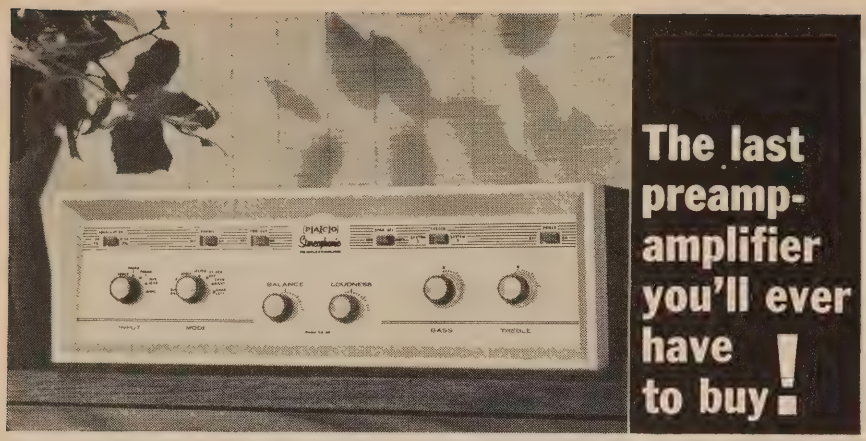
Name.....

Address.....

City.....Zone.....State.....

All prices net, F.O.B., N.Y.C.

- ☐ **Model 77** .....**Total Price $42.50**
  $12.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ **Model 80** .....**Total Price $42.50**
  $12.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ **Model TV-50A** .....**Total Price $47.50**
  $11.50 within 10 days. Balance $6.00 monthly for 6 months.
- ☐ **Model 79** .....**Total Price $38.50**
  $8.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ **Model 82A** .....**Total Price $36.50**
  $6.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ **Model TW-11**.....**Total Price $47.50**
  $11.50 within 10 days. Balance $6.00 monthly for 6 months.
- ☐ **Model 83** .....**Total Price $38.50**
  $8.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ **RCA Radiation Counter**.....**Total Price $47.50**
  $11.50 within 10 days. Balance $6.00 monthly for 6 months.



A new 40-watt stereo preamp-amplifier in kit form for only $79.95 by

PACO

also available factory wired for $129.95

PACO is the kit division of ***PRECISION*** Apparatus Co., Inc., world famous manufacturers of laboratory electronic instruments for over a quarter century. The new Model SA-40 is the first of a series of component high fidelity kits from PACO...engineered for utmost performance and lasting value—designed for maximum eye-appeal.

Whether you're an experienced audiophile or a newcomer to the thrill of high fidelity, the factors you must consider in choosing the amplifier you need are:
POWER, DISTORTION, FLEXIBILITY and VALUE.

The PACO SA-40 offers you greater reserve power capacity than any other preamp-amplifier in its category. Its exceptional circuit design assures highly stable performance with extremely low distortion. Step-by-step assembly instructions and giant-size wiring diagrams are so clearly detailed and simple that the technical difference between expert and novice disappears. And...the SA-40 provides maximum flexibility in *any* stereophonic high fidelity system...present or contemplated.

For those interested in engineering details, some of the more important technical specifications are listed below:

POWER OUTPUT:
Steady State Power Output: 20 watts per channel, 40 watts total.
Music Waveform Power Output: 25 watts per channel, 50 watts total.
Peak Power Output: 40 watts per channel, 80 watts total.
RESPONSE: 30 cps to 90 Kc, ± 1.0 db.
DISTORTION:
Harmonic: Less than .2% at 20 watts per channel output.
Less than .1% at 10 watts per channel output.
Intermodulation: Less than 1% at full rated output.
FRONT PANEL CONTROLS AND SWITCHES: 14 controls including separate bass and treble controls for complete flexibility with any monophonic or stereo program source.
INPUTS: 14 total; 3 dual high-level and 4 dual low-level.
OUTPUTS: Dual tape outputs, separate preamp output as well as standard dual speaker outputs.
HUM AND NOISE LEVEL:
High Level Input: 80 db below rated output.
Low Level Input: 70 db below rated output.
Tape Input: 65 db below rated output.
SPEAKER CONNECTIONS: 4, 8, 16, 32 ohms.
SENSITIVITY FOR RATED OUTPUT:
Aux Input: .75 V **Phono 1:** (Magnetic) 5 Mv.
Tuner: .75 V **Phono 2:** (Magnetic) 5 Mv. or Ceramic .3V
INVERSE FEEDBACK: 25 db
DAMPING FACTOR: 22
BASS TONE CONTROL RANGE: ±15 db at 50 cps.
TREBLE TONE CONTROL RANGE: ±15 db at 10 Kc.
RUMBLE FILTER: 6 db per octave below 50 cps.
EQUALIZATION: Phono: "RIAA"; "EUR";
Tape: 3¾ and 7½ ips, NARTB
TAPE OUTPUT LEVEL: 2 volts per channel.
POWER SUPPLY: Silicon diode, low impedance for minimum distortion on extended high level passages.
EXTERNAL DESIGN: Gold and satin black hooded case, with panel illumination and satin gold panel.
DIMENSIONS: 15⅜" wide x 11¾" deep x 5⅝" high
Model SA-40: Complete with case and step-by-step assembly-operating manual ..... **Kit Net Price $ 79.95**
Model SA-40W: Factory Wired ..... **Net Price $129.95**

Ask your own Audio-Radio-TV Serviceman about PACO and PRECISION products. He'll tell you that they always live up to their specs. That's why we can say that the PACO SA-40 is the last preamp-amplifier you'll ever have to buy

Available at leading electronic parts distributors and wherever good sound is sold.

For complete information write to:

PACO

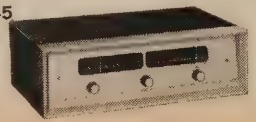
Electronics Co., Inc.
70-31 84th Street
Glendale 27, L. I., N. Y.

A Division of
PRECISION
Apparatus Company, Inc.

Export:
Morhan Exporting Corp.
458 Broadway
N. Y. 13, N. Y., U.S.A.

Canada:
Atlas Radio Corp., Ltd.
50 Wingold Ave.
Toronto 19, Ontario

COMING SOON — MODEL ST-45
AM/FM STEREO TUNER KIT
matching companion
for the SA-40



RADIO

(*Continued from page* 110)

than conventional receivers. (In FM sets, the limiters provide the noise-eliminating action.) Therefore, a noise limiter is not required.

Self-quenching detector

As can be seen in Fig. 1, the detector circuit would be an ordinary regenerative detector if it were not for the fact that the grid leak (R105) returns the grid to B-plus instead of ground, and also because of R105's high resistance.

In the Heath CB-1, the detector (a superregenerative type), is quenched at a rate of about 20 kc. The rate varies to some extent with the strength of the incoming signal as well as with the setting of R106, which adjusts detector plate voltage. Because of the complex waveforms generated by the combined effects of regeneration and quenching, a background hiss is heard in the speaker. When a signal is intercepted, the background noise is quieted, disappearing completely on a strong signal.

Testing the receiver

The audio amplifier consists of two stages. One section of a 12AX7, used as a voltage amplifier, feeds a 6AQ5 power amplifier. When transmitting, the other section of the 12AX7, functioning as a microphone preamplifier, is switched in ahead of V2-b.

When testing the receiver, we temporarily connected the inner conductor of the coaxial cable, leading to an antenna, to C101 and the cable shield to the chassis. The regeneration control (R106) was advanced just beyond the point where the background hiss started. After tuning in a weak signal, we adjusted L101's core until the background noise was at a minimum. The tuning dial calibration was set by turning the tuning dial to channel 23 and adjusting L102's core until we could hear tones being transmitted by class-C (radio-control) stations operating on 27.255 mc. (This channel is shared by class-C and -D as well as industrial, land-transportation and public-safety radio stations.)

Transmitter circuitry

When the wiring of the transmitter section and the transmit–receive switching circuits was completed, we were ready to check out the transmitter.

Hams will recognize the circuit as extremely simple. There are only two stages, exclusive of the modulator. A single 6AU8 is used—the triode section as a crystal-controlled oscillator, the pentode section as an rf power amplifier. Frequency is determined mainly by the crystal and, to a small extent, by the capacitance of the crystal holder tube socket, and the capacitance and inductance of the wiring on the grid side of V4-a. The tuning of L201 and L202, when correct, should not affect transmitting frequency.

Modulator system

Both the plate and screen of the rf

power amplifier are amplitude-modulated. The supply voltage to both is fed through T1's primary, which functions as the modulation reactor of a Heising modulator when transmitting. The plate voltage to the rf power amplifier must pass through the primary of T1 which acts as the modulation reactor, which is the modulator tube's plate load. When the modulator tube grid is swung positive and negative by an audio signal, the current through T1's primary increases as the modulator tube plate current rises and vice versa. The audio voltage developed across T1, therefore, alternately reverses in polarity. This voltage, which is in series with the rf amplifier plate voltage, varies the transmitter's rf output. At one instant, this voltage is in series-aiding with the supply voltage, increasing the transmitter output. At another instant, it is in series-opposing with the supply voltage, reducing the transmitter power output.

If the modulating voltage is so large when it is opposing the supply voltage that the rf amplifier plate actually goes negative, overmodulation is taking place. This should never be allowed to happen because the radiated signal can cause harmful interference. Overmodulation is prevented in the CB-1 by tapping T1's primary (Fig. 1). The tapped reactor is actually an autotransformer. The plate and screen voltage for the rf power amplifier is obtained at the tap where the modulating voltage will be less than the voltage developed across the entire winding of the modulator plate load. Overmodulation cannot occur because the modulator system tubes will start to limit (overload) when the audio signal voltage (from the microphone) gets too high. At the reactor, the audio voltage can't get high enough to cause overmodulation.

Switching circuits

A front-panel wafer switch is used for transferring the circuits from receive to transmit (Fig. 2). When switched from receive to transmit, it:

- Transfers the antenna from receiver to transmitter.
- Disconnects the speaker voice coil from the output transformer's secondary, converting the transformer into a modulation reactor.
- Grounds the cathodes of the oscillator and rf power amplifier tubes to activate the transmitter.
- Disconnects the plate voltage from the receiver section and applies plate voltage to the microphone preamplifier tube.
- Disconnects the receiver output from the audio amplifier and connects the output of microphone preamp to the input of the audio amplifier.

Transmitter tuning

Since the transmitter should be tuned initially when terminated in a dummy load, we connected a No. 47 pilot light to the antenna connector (Fig. 3). We also connected a vom (set to measure

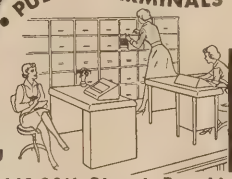
ATLAS PAGING SPEAKER STYLED FOR MODERN DÉCORS

The New Atlas DU-12 Perfect for the Most Discriminating Applications. For the first time here's a loudspeaker that doesn't look like one. Modeled along the sleek, straight lines of a modern lighting fixture, and finished in brushed satin aluminum, the Atlas DU-12 is styled to harmonize and enhance the most ultra of modern decors.

Acoustically, the Atlas DU-12 offers high intelligibility, efficiency and directivity — features that mark it as a fine quality loudspeaker. The frequency response of the DU-12 is "tailored" to reproduce speech with clean, crisp articulation. Its horn type construction and universal mounting bracket provide complete directional control, confining the sound coverage to the required service areas. And, there's no wiring exposed to mar its appearance because all connections and line matching transformer are completely hidden behind the mounting canopy. Canopy is equipped with adapter strap for mounting on any flat surface or for use on standard electrical outlet box. In commercial installations where both décor and true acoustical quality are important, the Atlas DU-12 is the only answer. Investigate the profit opportunities for yourself. Write for information on the complete line of Atlas P.A. speakers, mike stands and accessories.

Décor-Projector DU-12
List $35.00
Net $21.00

• HOTELS • DEPT. STORES • AIRPORTS • OFFICES • PUBLIC TERMINALS • BANKS • RESORTS •



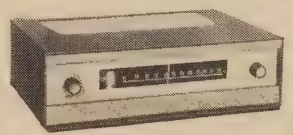
ATLAS SOUND

Write for complete Catalog

ATLAS Sound Corp. Dept. RE1, 1449 39th Street, Brooklyn 18, N. Y.
In Canada: Atlas Radio Corp., Ltd., Toronto, Ont.

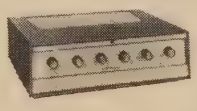
EASIEST TO BUILD — LAYER BUILT COLOR GUIDE

Grommes
DE LUXE HI-FIDELITY **KITS**

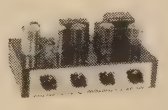


101GTK FM TUNER

Finest tuner kit offered! "Standard Coil" tuning unit is pre-wired, pre-aligned and can be tuned-in as soon as completed, without professional adjustments. Better reception than tuners costing 2 or 3 times as much. Latest circuits, matched crystal diode detector, Foster Seeley Discriminator, AFC, Electronic Tuning Eye. Quiet, drift-free. Simply and successfully assembled by anyone with screwdriver, pliers and soldering iron. Step-by-step instructions. Model 101GTK, only . . **$59.50**



20 WATT STEREO AMP.
De Luxe stereo at half the cost! Two 10 watt channels with 2 pre-amps. 40 watts peak. Frc. Res. ±0.5DB. 20-20,000 CPS. Complete controls.
20LJK **$59.50**



10 WATT AMPLIFIER
With built-in pre-amp. 20 watts peak. Frc. Res. ±1DB. 20-20,000 CPS. 4 inputs. Output: 4, 8, 16 ohms. Automatic Loudness Control.
LJ6K **$24.95**

Many other kits available—
At dealers or sent prepaid with check or M.O.

. . . . . **FREE!**

GROMMES Div. of Precision Electronics, Inc.
9101-H King Ave., Franklin Park, Ill.
Please rush details on Grommes Kit Line.

Name_____
Address_____
City_____State_____
Your Dealer's Name_____

Olson

FREE

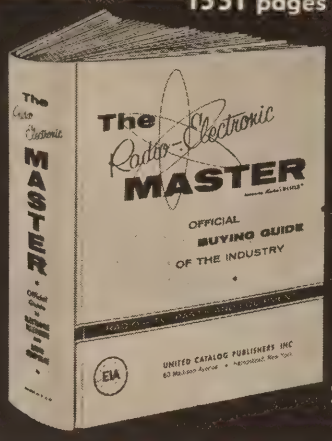
Fill in coupon for a FREE One Year Subscription to OLSON RADIO'S Fantastic Bargain Packed Catalog — Unheard of LOW, LOW, WHOLESALE PRICES on Brand Name Speakers, Changers, Tubes, Tools, Hi-Fi's, Stereo Amps, Tuners and thousands of other Electronic Bargains.

NAME_____
ADDRESS_____
CITY_____ZONE____STATE_____

If you have a friend interested in electronics send his name and address for a FREE subscription also.

OLSON RADIO CORPORATION
703 S. Forge St., Akron 8, Ohio

1551 pages



World's LARGEST Electronic Catalog

$3.50 at parts distributors $4.50 in Canada

1960 RADIO-ELECTRONIC MASTER

now available at your distributor

NEW...STREAMLINED...28 EASY-TO-USE PRODUCT SECTIONS COVER ALL LATEST PRODUCTS

• Printed circuit components • Stereo equipment • Miniature and sub-miniature components • Silicon rectifiers • New transistor types • Citizen's band, SSB and new mobile ham gear • Components and equipment for microwave and telemetering..... Plus every new electronic product for servicing, experimenting, design, industrial and military applications.

GREATER INCOME...SPEEDIER DESIGN & PURCHASING...MORE HOBBY FUN

SERVICE TECHNICIANS
More profitable operation. Covers all items necessary for Radio-TV-audio servicing. Offers thousands of products for extra income in hi-fi, sound and industrial servicing. You can buy, sell and bill direct from The MASTER...it shows list prices!

ENGINEERS & P.A.'s
Save time. Quickest way to get current factory-accurate data on all the products needed for research, design and production. Systematically organized in 28 product sections for rapid product comparison. Minute details so necessary for specifying.

HAMS, HOBBYISTS, EXPERIMENTERS
Get the right product to do the job because you shop in the electronic supermarket — The MASTER. Specifications, descriptions, prices of receivers, transmitters, hi-fi gear, cabinets and hard-to-locate items not found in smaller catalogs.

No matter what product or component you require...
YOU'LL FIND IT FASTER IN THE
1960 MASTER
RADIO ELECTRONIC MASTER, 58 Madison Ave., Hempstead, N.Y.

FREE...FROM YOUR DISTRIBUTOR
24-page Foreign Tube Interchangeability Guide or write direct enclosing 25¢ for handling

YOU CAN PASS "OK" THAT FCC EXAM!

FREE DETAILS!

•IF YOU HAVE A BACKGROUND IN ELECTRONICS, BUT ARE HAVING TROUBLE PASSING FCC COMMERCIAL PHONE EXAMS, MY 13 YEARS EXPERIENCE AS CHIEF INSTRUCTOR OF ELECTRONICS SCHOOL CAN HELP YOU OVER THE HUMP•NOT A COURSE. •MY "S-H-O-T-G-U-N" TYPE REVIEW HAS BEEN HIGHLY EFFECTIVE FOR 15 YEARS!•VERY INEXPENSIVE•SEND ME YOUR NAME & ADDRESS TODAY ON A POSTCARD for FREE LITERATURE!

WALLACE COOK
ELECTRONICS INSTRUCTION SPECIALIST
P·O·BOX 10634D·JACKSON 9·MISS.

YOU

will make easy profits showing the TV Lifesaver® on Service calls. Sells automatically—just show it. $4.95 List. See your jobber.
WUERTH Tube Saver Corp., Detroit 4, Mich.

TAPE RECORDERS

HI-FI COMPONENTS
SLEEP LEARN KITS

MERITAPE
Low cost, high quality recording tape, in boxes or cans.

UNUSUAL VALUES
FREE 1960 CATALOG

DRESSNER, 69-02RE 174 St., Flushing 65, N.Y.

50 ma dc full scale) through a phone plug to the test jack at the back of the chassis, to monitor rf power amplifier cathode current. As specified in the instruction book, we disabled the antenna filter (C209–L203) by adjusting C209 for less capacitance. Then we set the TRANSMIT–RECEIVE control to TRANSMIT and adjusted L201's slug until the dummy-load lamp glowed most brightly. Backing off (counterclockwise) on the slug, we alternately switched the transmitter on and off until we got to a point where the lamp went on each time without fail. Then we backed off the slug adjustment a quarter-turn more to obtain oscillator stability. The slug of L202 was then peaked for maximum dummy-load lamp brilliance.

Watching the vom, we noted that the cathode current varied as transmitter tuning adjustments were made. This is as it should be. When L202 is tuned to resonate at the operating frequency, the cathode current drops slightly.

Power measurement

The main reason for providing a cathode-current test jack is for measuring power input to the rf power amplifier. It must not exceed 5 watts, the legal limit. Our meter indicated 21 ma. Using the vom as a dc voltmeter, we measured the plate voltage at the junction of C207 and R204 and found it to be 235. The power input in watts, found by multiplying 235 volts by .021 ampere, was 4.935 watts.

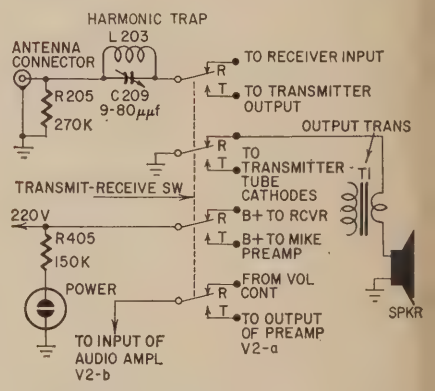


Fig. 2 — Transmit–receive switching circuits of the CB-1.

But we had more than .065 watt of margin, because cathode current includes screen as well as plate current. So we measured the voltage across R204, the screen dropping resistor; it was 80. The screen current—determined by dividing 22,000 ohms, the value of R204, into 80 volts—was 3.6 ma. Since the screen voltage, as measured between terminal 8 of the tube socket (V4-b) and the chassis, was 155, and the screen current was 3.6 ma, we determined that the screen power input was 0.558 watt. With input power to the plate actually only 4.377 watts (4.935 − 0.558 = 4.377), we had plenty of margin. Our line voltage is on the high side, as evidenced by the short life of light bulbs. Where line voltage is

normal (117 volts) or lower, transmitter power input will be less.

Not having an rf wattmeter, we could not measure the actual power output. However, the brilliance of the dummy load (No. 47 lamp) gives a very rough indication of power output. Burning at normal brilliancy, the lamp consumes 1 watt. At double its rated power (2 watts), its light output is approximately quadrupled.

Testing the transmitter

Now we were ready to test the transmitter with a live antenna. Because I am no longer interested in climbing steep roofs, we connected the transmitter through a length of RG-58/U coaxial cable to a Tele-Beam BMW ground-plane antenna suspended by a piece of nylon fishing line from a lighting fixture in a hallway.

As prescribed in the kit instruction book, we brought in our portable TV set, turned it on and then spoke into the microphone with the transmitter turned on. Sure enough, we were creating TVI as predicted. So, I adjusted C209 (part of the antenna trap) until our transmissions had the least effect on the TV set.

Fig. 1 shows that the trap is merely a parallel-resonant circuit in series with the antenna. When tuned correctly, it suppresses the second harmonic of the transmitter's signal. Because the rf power amplifier is operated class-C, its output contains not only the fundamental frequency but harmonics as well. The second harmonic is the strongest and falls right in the TV band. The trap is a filter which offers little opposition to the fundamental but a very high impedance to the second harmonic to which it is tuned.

Knowing that a No. 47 lamp is not really a good dummy antenna, but will do, we decided to retune the transmitter with the *live* antenna connected. (I have a commercial operator's license, so I can do it legally.) As an output indicator, we used a Heath PM-1RF power meter, actually a simple field-strength meter. It was placed a few feet away from the antenna and oriented so its meter scale could be seen while tuning the transmitter. A very slight readjustment of L202's slug gave maximum output. We tuned a ham receiver in another room to the transmitter frequency, using its S-meter as a supplementary field-strength indicator.

On-the-air tests

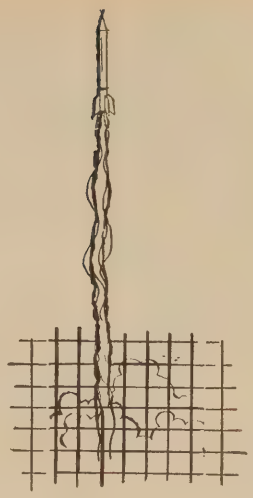
We were able to receive quite a few class-D stations on several channels, including mobile units as far distant as the Teterboro (N. J.) airport, 10 miles away, identifying their locations from their conversions.

Not having assembled the second kit yet, we made initial tests, listening to our transmitter with an RME 4303 walkie-talkie which can be tuned to any frequency in the band. Using a factory-made Citizens radio in a car as a mobile station, we could communicate solidly

ELECTRONIC TECHNICIANS AND INSTRUCTORS—

You Can Realize Your Full Professional Potential with

Burroughs



Advance your career in the most critical field of tomorrow: integrated DATA PROCESSING for military weapons systems at BURROUGHS, Military Field Service Division. Participate in challenging work on important long range ATLAS and SAGE programs.

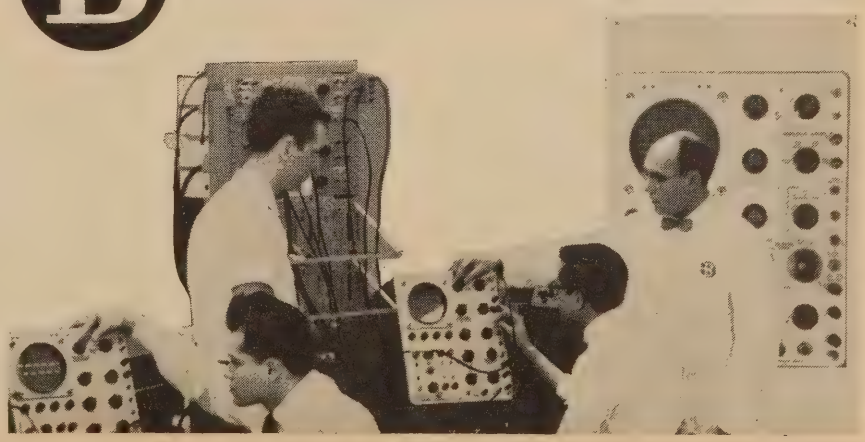
You can qualify as TECHNICIAN if you are a graduate of an accredited technical school and/or have military training in radar or communications equipment, plus at least 2 years' experience in electronics. You will receive 8 to 22 weeks of classroom training in Data Processing Systems at full salary. Current field assignments include far-West and Western areas after your training is completed....You can qualify as INSTRUCTOR if you have a knowledge of electronics theory and some related teaching experience. Work involves the training of technical personnel in the installation, maintenance and repair of electronic and/or electro-mechanical equipment.

The above positions carry these exceptional benefits: 1) Advancement based on individual performance. 2) Starting salary commensurate with experience and ability. 3) Merit review program. 4) Outstanding group insurance and retirement plan. 5) Generous educational assistance program. Inquiries are invited from qualified candidates. Please write Mr. R. F. Johnson, Dept. 2393, Burroughs Corporation, Military Field Service Division, Burroughs Drive, Radnor, Pa. (a suburb of Philadelphia).

Burroughs

Burroughs Corporation

"NEW DIMENSIONS/in computation for military systems"



GONSET

NEW! . . . MULTI-CHANNEL

2-WAY RADIO

Low Cost **G-12**

Citizens Communicator

A complete 4-channel radio station . . . for virtually unlimited business or personal use in vehicle, office, boat, plane

Operates on new 11-meter Citizens Band. Easy to obtain station license . . . no code, no exams. U.S. Citizens required only to complete simple F.C.C. form.

HUNDREDS OF USES!

units may operate together as a system. Examples: Industrials . . . buildings . . . yards . . . warehouses . . . aviation . . . branch businesses . . . fixed station to car or truck. Also for farm . . . ranch . . . mining . . . construction . . . sports . . . fishing . . . boating . . . hunting . . . sporting events . . . outdoors.

RUGGED . . . DEPENDABLE . . .

Full feature Citizens Band Radio. No tuning . . . has quartz crystal-controlled channels for highest stability, reliability. Easy, press-to-talk operation . . . has front panel channel selector, noise limiter, superhet receiver with RF stage, adjustable squelch, transmitter tuning indicator, built-in speaker. Is fully FCC type accepted.

Employs latest electronic design techniques. Compact! Only 4½" H, 7" W, by 10" D. Weighs 11 lbs. Has gimbal mount, built-in 12VDC/117VAC universal power supply for fixed or mobile service.

149.95 per unit

WITH P-T-T MICROPHONE AND TRANSMITTER/RECEIVER CRYSTALS FOR ONE CHANNEL.

Send coupon for FREE Citizens Band Booklet . . .

GONSET DIVISION Dept. RE
Young Spring & Wire Corp.
801 South Main Street, Burbank, Calif.

Gentlemen: Rush complete details on your Citizens' Band radio, and free booklet

NAME

ADDRESS

CITY ZONE STATE

GONSET

Division of Young Spring & Wire Corporation

801 SOUTH MAIN ST., BURBANK, CALIFORNIA

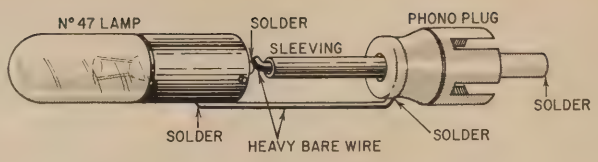


Fig. 3—A simple dummy-load antenna.

within a radius of 1 mile (and for another ½ mile, with some noisy spots). Both sets had approximately the same range.

A small difference in antenna height made a big difference in signal strength at a distance of 1½ miles. Raising the antenna only a couple of feet higher made a noticeable difference.

I plan to have the antenna installed on top of a pipe on the peak of our three-story house. This should give a big increase in range. Since our house is in a heavily wooded area, range is limited, particularly when using an indoor antenna. It will be necessary to get the antenna up above the trees. Nothing reduces communicating range at these frequencies as much as trees and dense foliage. The tests were conducted in the fall just as the leaves had started to drop. The range, even when using an indoor antenna, should increase considerably when the leaves are gone.

Antenna requirements

Others using various makes of Citizens radio report similar results. Many get up to 10-mile coverage with CB-1 units. But, for extended range, a base-station antenna mounted clear of nearby trees is generally required. In vehicles, range can be increased considerably by installing suppressors and bonding straps to reduce ignition noise. Even the inherent noise-suppression characteristics of the superregenerative detector and the noise silencer used in superheterodyne type sets will not provide more than partial relief from ignition noise, which is particularly pronounced at 27 mc. It is the level of the noise which determines the *effective* sensitivity of the receiver. Too bad something can't be done about the noise generated by passing cars.

Do's and don't's

There are a few salient points to consider when building and testing a Citizens radio. First of all, follow the wiring procedures outlined in the instruction book. Follow instructions *precisely* when wiring the crystal circuit so that variations in lead length and placement won't affect frequency.

When tuning up the transmitter, do so only with a dummy antenna. Do *not* touch the transmitter tuning adjustments when the set is connected to an antenna unless you have a first- or second-class radiotelephone operator's *license* or are in the presence of a licensed operator.

Do not transmit until you have *listened first* to make sure that your channel is not in use. To do so, you must have your receiver tuned to your transmitting frequency. If you do not know the exact dial setting for your channel, tune the receiver back and forth over that part of the dial.

Also, before transmitting, make sure a Conelrad alert does not exist. All Citizens radio stations must have provisions for receiving the Conelrad alert and all clear. It is not a matter of choice. It is mandatory. This means that you must have an automatic Conelrad monitor, or an AM broadcast receiver or TV set *turned on* and *listened to* before transmitting.

Make all on-the-air transmitter tests as short as possible to avoid causing interference to others. At the start of the test, you must announce your station's assigned call sign. The call sign must be announced at the beginning and end of every communication, except when exchanging a series of short transmissions. When conducting a series of test calls, the call sign must be announced at least every 10 minutes.

Station license

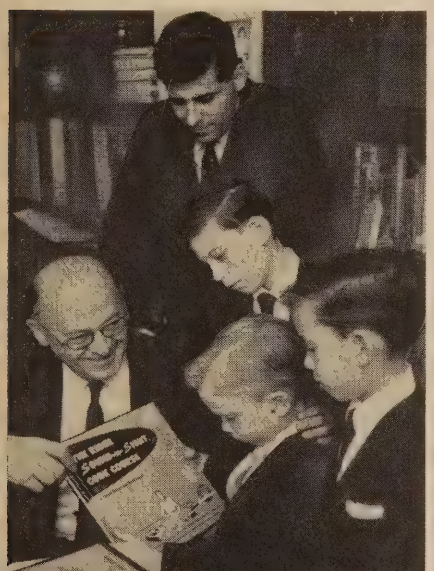
At the time of ordering your Citizens radio kits, or even before, get your station license application in the mail. (Allow at least 6 weeks for processing.) Without a license, you can't put your

The Heathkit CB-1 Citizens-band transceiver set up and ready for use.

equipment on the air. You can get license application forms at most parts jobbers that sell Citizens radio equipment or by requesting Form 505 from the Federal Communications Commission, Washington 25, D. C. This simple form, when filled in, must be notarized before being mailed to the FCC. One license application can cover any number of transmitters, of any make or type, as long as they meet the requirements specified in part 19 of the FCC rules and regulations. The latest issue of these Citizens Radio Service rules is contained in a brand new book, *Vol. VI, FCC Rules and Regulations*, which also contains the rules for the amateur and disaster service. It may be purchased from the U. S. Government Printing Office, Washington 25, D. C. for $1.25. You must have a copy of the rules on hand, since ignorance of the rules will not exempt you from violation citations or cancellation of your license. END

LEARNS CODE AT 5

Robert Alessi, 5 years old, shows his skill in International Morse code to John F. Rider, publisher, and Lewis Robins, author of the Sound-n-Sight code course. His older brother, Frank, age 9, recently passed his General-class Amateur exam. Frank is believed to be the second youngest boy ever to get his General, the youngest having been



a blind boy, John Fearon, 7, of Atlanta, Ga. Robert and Frank have an older brother Patrick, 10, who also has his General class license. But the remarkable thing about Robert is that he has learned to read the code while he is still unable to read English.

The youngest girl ever to get an Amateur radio license is Sharon Pakinas, who passed her novice exam at the age of 7 and has since passed the Technician tests.

ALL TUBES INDIVIDUALLY BOXED . . . UNCONDITIONALLY GUARANTEED ONE YEAR SEND FOR FREE COMPLETE TUBE LIST & ORDER BLANK INQUIRY PUTS YOU ON MAIL-LIST

TELTRON SMASHES PRICES on TUBES for '60!

GIFT OFFER
ONE 6BG6G tube will be shipped FREE with any $10.00 or more order accompanying this ad.

FREE
$7.50 list value. Bonus box includes 3 6SN7 tubes & 25 assorted resistors & condensers with each order of $25.00 or more of receiving tubes and special purpose tubes only.

FREE EICO TUBE TESTER

By popular demand we are repeating this fabulous FREE GIVE-AWAY. You get this EICO tube tester kit #625K ABSOLUTELY FREE when you purchase $199.00 worth of receiving tubes from TELTRON within 60 days.
Tube tester may be purchased outright for $34.95 PREPAID. Send for FREE list of other EICO test equipment & HI FI components that we distribute.

PARTIAL LIST MOST OFTEN USED TUBES

0Z4	.45	6BA8	.49	9U8	
1B3GT	.62	6BC5	.48	10DE7	.79
1R5	.51	6BC8	.59	12AB5	.49
1S5	.43	6BE6	.86	12AF6	.44
1T4	.51	6BF5	.48	12AT6	.37
1U4	.51	6BG6G	1.18	12AT7	.71
1U5	.43	6BH6	.51	12AU6	.43
1X2	.62	6BJ6	.51	12AU7	.58
2AF4	1.02	6BK5	.75	12AV6	.42
2BN4	.55	6BK7	.78	12AV7	.73
3AU6	.43	6BL7GT	.78	12AX4GT	.60
3BC5	.58	6BN4	.44	12AX7	.61
3BN6	.90	6BN6	.90	12AZ7	.65
3BZ6	.45	6BQ6GT	.83	12B4	.52
3CB6	.51	6BQ7A	.85	12BA6	.46
3DT6	.51	6BY5G	.75	12BE6	.46
3V4	.48	6BZ6	.45	12BH7	.61
4BC8	.69	6BZ7	.95	12BQ6	.63
4BQ7	.75	6C4	.41	12BY7	.65
4CB6	.51	6CB6	.51	12CR6	.43
5AN8	.59	6CG6G	1.63	12CU6	.63
5AT8	.64	6CF6	.45	12DB5	.59
5AV8	.54	6CG7	.48	12DQ6	.63
5BK7	.54	6CH8	.54	12K5	.44
5J6	.68	6CM7	.44	12SA7	.45
5T8	.61	6CS6	.45	12SK7	.45
5U4G	.59	6CU6	.95	12SN7GT	.56
5U4GA	.43	6DE6	.43	12SQ7	.38
5U4GB	.45	6DG6GT	.50	12V6GT	.43
5U8	.45	6DQ6	.89	12L6GT	.43
5V4G	.59	6H6	.47	12W6GT	.47
5X8	.49	6J5	.49	17Q6	.43
5Y3GT	.55	6J6	.61	19AU4	.68
6AB4	.30	6K6GT	.39	19BG6G	1.60
6AC7	.43	6S4	.41	25BQ6GT	1.48
6AF4	.65	6SA7	.45	25CD6G	.82
6AG5	1.02	6SC7	.54	25CU6	1.19
6AH6	.52	6SK7	.45	25L6GT	.82
6AL5	.47	6SL7GT	.60	25W4GT	.41
6AM8	.43	6SN7GT	.60	25Z6GT	.43
	.59	6SQ7	.38	35B5	.36
					.48

Send for FREE complete list of most often used tube types.

NEW AND HARD TO GET TYPES PROMPT DELIVERY

1DN5	.60
1G3GT/1B3	.70
2CY5	.50
3AF4	1.02
4DE6	.55
4DT6	.59
5CQ8	.59
6BJ8	.64
6BQ5	.74
6CQ8	.59
6CX8	.64
6DS5	.69
8AW8	.75
8CX8	.90
11CY7	.74
12EK6	.59
17AX4GT	.50
17D4.50 50EH5	.59

APPROX. COST ANY TYPE. EXCESS REFUNDED.

Obsolete, seldom used tubes. Immed. delivery.

1A6	.93	7B4	.44
1C5GT	.57	7B5	.41
1C7G	.39	7B8	.47
1F5	.39	7C5	.44
1H4G	.39	7F8	.77
1LA6	.66	7H7	.51
1LB4	.69	7N7	.52
1LH4	.66	7V7	.82
1LN5	.66	7Y4	.35
3LF4	.66	7Z4	.40
5T4	.59	12A8GT	.45
6A7	.59	12K7GT	.40
6A8	.40	12Q7GT	.48
6AB7/		12SR7	.57
1853	.60	14A7	.43
6AQ7GT	.60	14B6	.36
6AS7G	1.50	14Q7	.52
6D6	.59	27	.45
6F5GT	.44	35A5	.48
6F6	.42	35Y4	.35
6S7	.89	37	.57
6SB7Y	.50	39/44	.39
6SR7	.43	45	.55
6U5	.54	50A5	.48
6U7G	.43	50X6	.53
7A4/		56	.48
XXL	.47	71A	.65
7A6	.47	75	.44
7A8	.46	77	.55
7A7	.42	80	.40

Semiconductors for immediate delivery.

1N34	.49
1N38	.95
1N60	.34
1N66	.49
1N82A	1.00
1N253	4.25
1N295	19.95
1N295	.30
1N460A	4.60
1N1096	9.00
2N43	3.75
2N130A	2.75
2N329A	40.00
2N484	1.75
2N622	30.00
2N633	1.35

Special-purpose, transmitting and industrial Tubes for immediate delivery.

0A2	.70	807	1.00
2A4G	.75	811A	3.25
2D21	.65	813	9.25
2E26	2.50	833A	40.00
2X2	.75	866A	1.00
5R4GY	1.00	2050	.85
6J4	1.00	5675	12.25
12A6	.60	5879	1.10
FG27	8.50	6146	3.85
HY69	1.75	6161	34.50

NEW PRICE SCHEDULE OF TELEVISION PICTURE TUBES
PICTURE GUARANTEED FOR ONE (1) YEAR

8DP4	*	17EP4	$13.25	21AVP4	$19.25
10ABP4	*	17FP4	17.25	21AWP4	18.75
10BP4	$ 7.95	17GP4	17.95	21EP4	17.25
12LP4	10.75	17HP4	16.49	21FP4	19.25
14BP4	11.75	17JP4	16.49	21MP4	21.25
14CP4	11.95	17LP4	17.45	21WP4	17.25
14QP4	13.25	17QP4	13.25	21XP4	18.75
14RP4	14.25	17TP4	16.49	21YP4	18.75
16AP4	16.45	17YP4	16.49	24ZP4	17.25
16CP4	12.45	19AP4	18.25	24ADP4	*
16DP4	11.99	20CP4	15.75	24AP4	*
16EP4	15.95	20DP5	15.75	24CP4	27.25
16GP4	15.99	20HP4	17.75	24DP4	28.75
16HP4	12.49	21ACP4	21.95	24TP4	*
16KP4	11.95	21ALP4	18.75	24VP4	*
16LP4	11.95	21AMP4	18.75	24YP4	*
16RP4	11.95	21AP4	21.25	24EP4	*
16TP4	11.95	21ATP4	19.25	27RP4	*
17ATP4	16.75	21AUP4	19.25		
17AVP4	15.75				

*Price upon request
ALUMINIZED ON ANY TUBE, $4.00 EXTRA
All picture tubes require a deposit on your dud. Please add an additional $5.00 on tube sizes to 17". Add $7.00 on sizes 19", 20", 21" and 24"s. Your cash deposit will be refunded immediately upon receipt of your dud prepaid. Picture tubes are shipped promptly from our warehouse (the US continent and Canada only) F.O.B. Harrison, New Jersey.

RECEIVING TUBE SPECIALS

6SN7GT A & B	
Lots of 50	$24.50
Lots of 100	$44.50
6W4GT	
Lots of 50	$18.95
Lots of 100	$34.95
12AU7 & A	
Lots of 50	$24.95
Lots of 100	$47.95
6AU6 & A	
Lots of 50	$18.95
Lots of 100	$34.95
6CB6 & A	
Lots of 50	$22.95
Lots of 100	$41.95
Free Postage	

HEAVY DUTY SOLDER GUN KIT. 135 w gun. Dual spotlight illum. work when gun on. INCL: wire soldering brush & aid to make tight twists, reopen old joints, 1ge. pkg. solder. Prepd., $4.99. 3 for $14.29.

FIBER FUSE CLIPS.....15c ea.
12 for $1.65
PREPAID

RCA CHEATER CORDS
39c ea.
6 for $1.95
PREPAID

Complete Outdoor ALL CHANNEL CONICAL ANT. local/fringe areas. 8 elem. ant. with crossbar. 5' seamless mast (alum.), chimney mt. or 7" wall brkt. (state need) 8 standoffs, 50' 300 ohm wire. 3 -57.49. Imm. dl. FOB Harrison, N.J.

SWITCH-TYPE Indoor Antenna
Shipped postage paid. New 6 position switch for use on UHF, VHF and color sets. Attractively packaged $2.99, lots of 6 $2.49.

PARALLEL PICTURE TUBE BRIGHTENER 99c
Series type.....$1.39

AUTO VIBRATORS
6 Volt 4 Prong
Universal $1.59
12 Volt 3 Prong
Standard $1.79
12 Volt 4 Prong
Standard $1.99

NEW LIBERAL TERMS: NO MINIMUM ORDER. FREE POSTAGE ON ALL TUBE & PARTS ORDERS OVER $5.00 IN U.S.A., APOs & TERRITORIES. 25% DEPOSIT REQUIRED ON CODs. PLEASE SEND APPROXIMATE POSTAGE ON CANADIAN AND FOREIGN SHIPMENTS. EXCESS WILL BE REFUNDED. All picture tubes and outdoor antennas shipped FOB Harrison, New Jersey.

TUBES LISTED MAY BE FACTORY SECONDS OR USED TUBES AND CLEARLY MARKED.

TELTRON ELECTRIC CO. Dept. RE-1
428 Harrison Ave. Harrison, N. J. Phone HUmboldt 4-9848

RECORDING TAPE
Premium Quality—10-day money back guarantee
1800' Mylar, made by Minn. Mining & Mfg. Co.
.....3 for $6.65
2400' Mylar.....3 for $9.60
Lots of 10, any assortment, deduct 10%
Add postage 15c per spool.
DON'T BUY HI-FI components, kits, tape recorders, until you get our low, low quotes by return mail. Wholesale Catalog Free.
HI-FIDELITY CENTRE
1799R 1st Ave., New York 28, N.Y.

FREE! CATALOG OF HI-FI, RADIO, TV PARTS & ACCESSORIES — yours for the asking!
Vidaire ELECTRONICS MFG. CORP.
44 CHURCH ST. • BALDWIN, N.Y.

ENGINEERING
B. S. DEGREE IN 27 MONTHS
Prepare for unlimited opportunities of the Electronic Age! Students study engineering under accelerated program leading to B.S. degree in 27 mo.; or standard 4-yr. program leading to B.E. degree in 36 mo. B.S. degree (36 mo.) in Math., Chem., Physics. Year-round classes. Comprehensive training in electronics, television, advanced radio theory and design, math., nuclear physics and elec. eng. Also prep courses. Low rate. Earn board. G.I. approved. Enter March, June, Sept., Dec. Catalog.
INDIANA TECHNICAL COLLEGE
1710 E. Washington Blvd., Fort Wayne 2, Indiana
Please send me free information on B.S. ENGINEERING DEGREE IN 27 MONTHS as checked.
☐ Electronics ☐ Chemical ☐ Aeronautical
☐ Civil ☐ Mechanical ☐ Electrical
B.E. DEGREE IN 36 MO. in: ☐ Electrical (Power or Electronics)
☐ Aeronautical ☐ Chemical
☐ Civil ☐ Mechanical ☐ Metallurgical
B.S. DEGREE IN 36 MO. in: Math. ☐ Chem. ☐ Physics ☐
Name.....
Address.....

SHIPPED ON APPROVA

NEW

CRT TESTER-REACTIVATOR Model CRT-2

Housed in hand-rubbed oak carrying case — complete with MULTI-HEAD*

Model CRT-2 $57.50 Net

TERMS: $13.50 within 10 days. Balance $11 monthly for 4 months.

NOW . . . a TESTER-REACTIVATOR really designed to test, repair and reactivate EVERY PICTURE TUBE MADE — whether black and white or color . . . with exclusive features never before found in picture tube testers.

1. THE MULTI-HEAD (patent pending) . . . A SINGLE PLUG IN CABL AND UNIQUE TEST HEAD — A tremendous advance over the maize c cable and adapters generally found with other testers. Enables you to tes repair and reactivate every type of picture tube with greater convenience tha ever before . . . 50 degree to 110 degree types from 8" to 30", whether 12 pi base, 8 pin base, 14 pin base . . . even the very latest 7 pin base. A specia color switch on the MULTI-HEAD enables you to test, repair and reactivat each of the red, green and blue color guns separately.

2. WATCH IT REACTIVATE THE PICTURE TUBE — You actually see and co trol the reactivation directly on the meter as it takes place, allowing you f the first time to properly control the reactivation voltage. This eliminates th danger of stripping the cathode of the oxide coating. It enables you to see th speed of reactivation and whether the build-up is lasting. You will see if th cathode contamination is too great and if the picture tube is too far gone be reactivated.

3. CONTROLLED "SHOT" WITH HIGHER VOLTAGE FOR BETT REACTIVATION — Stronger than any found in other testers . . . high enou to really do the job — yet controlled to avoid damage to the picture tub

4. UNIQUE HIGH VOLTAGE PULSE CIRCUIT — Will burn out inter-eleme shorts and weld open circuits with complete safety to the picture tube.

5. VISUAL LIFE TEST — Enables both you and your customer to see the li expectancy of any picture tube right on the meter. The fact that your c tomer can see the results of your tests as you make them virtually elimina resistance to picture tube replacement when necessary.

6. TESTS, REPAIRS AND REACTIVATES SPECIAL LOW SCREEN VOLTA TUBES — Many new type picture tubes use special low voltage of appr mately 50 volts. The CRT-2 will test, repair and reactivate these types w the same thoroughness as the regular types with complete safety.

7. SEPARATE FILAMENT VOLTAGES — Including the very latest 2.35 and 8.4 volt types as well as the older 6.3 volt types.

8. TESTS, REPAIRS AND REACTIVATES 'SF' PICTURE TUBES — found the newest Sylvania and Philco TV sets. These picture tubes have diffe base pin connections than standard picture tubes and there is always element of risk that the tube may be burned out when tested with ordi picture tube testers. The CRT-2 is designed to accommodate this new b pin arrangement and will test the tube with no danger of damage.

The CRT-2 steps in and solves the limitations and shortcomings of present day CRT Testers. Unlike ordinary CRT testers that keep entering the field with a limited range of operation, the CRT-2 employs a new brilliantly engineered circuit designed to test, repair and reactivate every black and white or color picture tube made. The CRT-2 eliminates the guesswork and risk that until now, has always been present when a picture tube is reactivated. It accomplishes this by providing perfect control of either the 'Boost' or 'Shot' method of reactivation.

THE CRT-2 DOES ALL THIS RIGHT IN THE CARTON, OUT OF THE CARTON OR IN THE SET

TEST

- for quality of every black and white and color picture tube
- for all inter-element shorts and leakage up to one megohm
- for life expectancy

REPAIR

- Will clear inter-element shorts and leakage
- Will weld opens between any two elements in the tube gun

REACTIVATE

- The unique controlled 'SHOT' (high voltage pulse) method of reactivation provided by the CRT-2 will restore picture tubes to new life in instances where it was not possible before. Furthermore the high voltage is applied without danger of stripping the cathode as you always have perfect control of the high voltage pulse.
- The 'BOOST' method of reactivation also provided by the CRT-2 is used effectively on tubes with a superficially good picture but with poor emission and short life expectancy. It will improve definition, contrast and focus greatly and add longer life to the picture tube.

ADDITIONAL FEATURES

• Employs the time proven dynamic cathode emission test principle • Large meter with heavily damped movement for smooth action, accuracy and long • Provides separate shorts test for each element in the picture tube • Filar continuity is shown on a separate glow indicator • An easy to read instruc manual contains all the latest testing information on old and new type pic tubes • Housed in handsome hand-rubbed oak carrying case with special com ment for MULTI-HEAD and line cord.

* patent pendi

IN-CIRCUIT CONDENSER TESTER Model CT-1

Here is an IN-CIRCUIT CONDENSER that DOES THE WHOLE JOB! The CT-1 actually steps in and takes over where all other in-circuit condenser fail. The ingenious application of a dual bridge principle gives the CT-1 a tremendous range of operation . . . and makes it an absolute 'must' for every serviceman.

in-circuit checks:

- Quality of condensers even with circuit shunt resistance . . . (This includes leakage, shorts, opens, intermittents)
- Value of all condensers from 200 mmfd. to .5 mfd.
- Quality of all electrolytic condensers (the ability to hold a charge)
- Transformer, socket and wiring leakage capacity

out-of-circuit checks:

- Quality of condensers . . . (This includes leakage, shorts, opens and intermittents)
- Value of all condensers from 50 mmfd. to .5 mfd.
- Quality of all electrolytic condensers (the ability to hold a charge)
- High resistance leakage up to 300 megohms
- New or unknown condensers . . . transformer, socket, component and wiring leakage capacity

OUTSTANDING FEATURES

- Ultra-sensitive 2 tube drift-free circuitry
- Multi-color direct scale readings for both quality and value . . . in-circuit or out-of-circuit
- Simultaneous readings of circuit capacity and circuit resistance
- Built-in hi-leakage indicator sensitive to over 300 megohms
- Cannot damage circuit components
- Electronic eye balance indicator for every greater accuracy
- Isolated power line
- Housed in sturdy hammertone finish steel case . . . comes complete with test leads

Model CT-1 $34.50 Net

TERMS: $9.50 within 10 days. Balance $5 monthly for 5 months.

OR 10 DAY *FREE* TRIAL

Convince yourself at no risk that CENTURY instruments are indispensable in your every day work. Send for instruments of your choice without obligation . . . try them for 10 days before your buy . . . only then, when satisfied, pay in easy-to-buy monthly installments — without any financing or carrying charges added.

NOW a Battery Operated Peak-to-Peak VACUUM TUBE VOLT METER Model VT-1

WITH LARGE EASY-TO-READ 6" METER —

aturing the sensational new MULTI-PROBE * Patent Pending

No extra probes to buy! The versatile MULTI-PROBE does the work of 4 probes

DC Probe ❷ AC-Ohms Probe ❸ Lo-Cap Probe ❹ RF Probe

The VT-1 is a tremendous achievement in test equipment. With its unique MULTI-PROBE it will do all the jobs a V.T.V.M. should do without the expense of buying additional probes. No longer do you have to cart around a maize of entangled cables, lose time alternating cables or hunting for a misplaced probe. With just a twist of the MULTI-PROBE tip you can set it to do any one of many time-saving jobs. A special holder on side of case keeps MULTI-PROBE firmly in place ready for use.

Housed in hammertone steel-case — complete with MULTI-PROBE

FUNCTIONS

C VOLTMETER . . . Will measure D.C. down to volts full scale with minimum circuit loading. d give accurate readings of scale divisions as low .025 volts . . . Will measure low AGC and oscillator s voltages from .1 volts or less up to 1500 volts h consistent laboratory accuracy on all ranges . . . o center provided for all balancing measurements ch as discriminator, ratio detector alignment and fi amplifier balancing.

C VOLTMETER . . . True Peak-to-Peak measurents as low as 3 volts of any wave form including sync, deflection voltages, video pulses, distortion hi-fi amplifiers, AGC and color TV gating pulses . . . ale divisions are easily read down to .1 volts . . . asures RMS at 1/20th the circuit loading of a .M. . . . Unlike most other V.T.V.M.'s there is no s in accuracy on the lowest AC range.

ECTRONIC OHMETER . . . Measures from 0 1000 megohms . . . Scale divisions are easily read wn to .2 ohms . . . Will measure resistance values m .2 ohms to one billion ohms . . . Will detect h resistance leakage in electrolytic and by-pass ndensers.

and LO-CAP MEASUREMENTS . . . h these extra VT-1 functions you can measure tages in extremely high-impedance circuits such sync and AGC pulses, driving saw tooth voltages, or TV gating pulses, mixer output levels, I.F. ge-by-stage gain and detector inputs.

OUTSTANDING FEATURES

- Completely portable — self powered with long life batteries — permits use everywhere
- New advanced pentode amplifier circuit assures amazingly low battery drain
- Large 6" 100-microampere meter, many times more sensitive than meters used in most V.T.V.M.'s
- Laboratory accuracy performance — 2% of full scale on DC, 5% of full scale on AC
- Simplified multi-color easy-to-read 4-scale meter
- No heat operation assures rigid stability and accuracy
- Immune to power line fluctuations
- Amplifier rectifier circuit with frequency compensated attenator — a feature found only in costly laboratory instruments
- Meter completely isolated — practically burn-out proof
- Hand-crafted circuitry eliminates the service headaches of printed circuitry
- 1% resistors used for permanent accuracy
- Separate RF ground return for low-loss RF measurement
- Microphone type co-axial connector
- Matching cover protects instrument face — snaps on and off instantly.

SPECIFICATIONS

- DC Volts — 0 to 1.5/6/30/150/300/600/1500 volts
- AC Volts (RMS and Peak-to-Peak) — 0 to 3/12/60/300/1200 volts
- Ohms — 0 to a billion ohms, 10 ohms center scale — Rx1/10/100/1K/10K/100K/1M
- RF — Peak reading demodulator supplied for use on all DC ranges
- Zero Center — available on all DC volt ranges with zero at mid-scale
- Decibels — from —10 Db to +10/22/36/50/62 based on the Dbm unit: ODb-1MW in 600 ohms
- Impedance — 11 megohms DC, 1 megohm AC, 10 megohms Lo-Cap
- Input Capacity — 130 mmfd. RMS, 250 mmfd. Peak-to-Peak, 25 mmfd. Lo-Cap

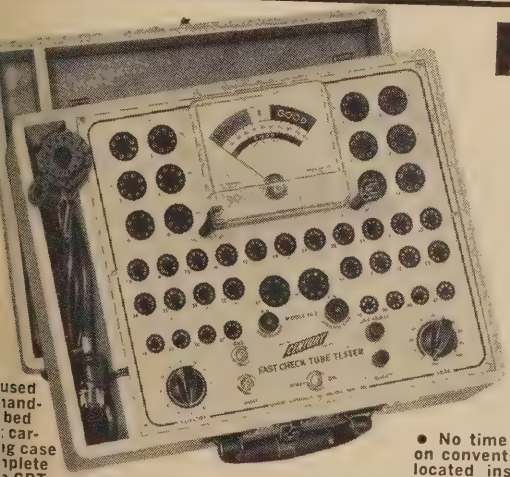
Model VT-1 $58.50 Net

TERMS: $14.50 within 10 days. Balance $11 monthly for 4 months.

FAST-CHECK TUBE TESTER Model FC-2

Simply set two controls . . . insert tube . . . and press quality button to test any of over 700 tube types completely, accurately . . . IN JUST SECONDS!

Over 20,000 servicemen are now using the FAST-CHECK in their every day work and are cutting servicing time way down, eliminating unprofitable call-backs and increasing their dollar earnings by selling more tubes with very little effort. See for yourself at no risk why so many servicemen chose the FAST-CHECK above all other tube testers.



used
and-
bed
car-
g case
plete
CRT
pter

PICTURE TUBE TEST ADAPTER INCLUDED WITH FAST-CHECK

Enables you to check all picture tubes (including the new short-neck 110 degree type) for cathode emission, shorts and life expectancy . . . also to rejuvenate weak picture tubes.

RANGE OF OPERATION

- Checks quality of over 700 tubes types, employing the time proven dynamic cathode emission test. This covers more than 99% of all tubes in use today, including the newest series-string TV tubes, auto 12 plate-volt tubes, OZ4s, magic eye tubes, gas regulators, special purpose hi-fi tubes and even foreign tubes.
- Checks for inter-element shorts and leakage.
- Checks for gas content.
- Checks for life-expectancy.

SPECIFICATIONS

- No time consuming multiple switching . . . only two settings are required instead of banks of switches on conventional testers
- No annoying roll chart checking . . . tube chart listing over 700 tube types is located inside cover. New listings are added without costly roll chart replacement
- Checks each section of multi-section tubes and if only one section is defective the tube will read "Bad" on the meter scale
- 41 phosphor bronze beryllium tube sockets never need replacement
- 7-pin and 9-pin straighteners mounted on panel
- Large 4½" D'Arsonval type meter is the most sensitive available, yet rugged — fully protected against accidental burn-out
- Special scale on meter for low current tubes
- Compensation for line voltage variation
- 12 filament positions
- Separate gas and short jewel indicators
- Line isolated — no shock hazards
- Long lasting etched aluminum panel.

NOTE: The Fast-Check positively cannot become obsolete . . . circuitry is engineered to accommodate all future tube types as they come out. New tube listings are furnished periodically at no cost.

Model FC-2 $69.50 Net

TERMS: $14.50 within 10 days. Balance $11 monthly for 5 months.

CONVENIENT TIME PAYMENT PLAN — NO FINANCING CHARGES

L CENTURY
STRUMENTS ARE
IARANTEED FOR
E FULL YEAR
e extremely low
ices are made
ssible because
u are buying di-
ct from the

CENTURY ELECTRONICS CO., INC.

111 Roosevelt Avenue, Dept. 101, Mineola, New York

CHECK INSTRUMENTS DESIRED

- ☐ Model CRT-2 CRT TESTER REACTIVATOR ..... $57.50 — $13.50 within 10 days. Balance $11 monthly for 4 months.
- ☐ Model CT-1 In-Circuit Condenser Tester ..... $34.50 — $9.50 within 10 days. Balance $5 monthly for 5 months.
- ☐ Model VT-1 Battery Vacuum Tube Volt Meter ..... $58.50 — $14.50 within 10 days. Balance $11 monthly for 4 months.
- ☐ Model FC-2 Fast-Check Tube Tester ..... $69.50 — $14.50 within 10 days. Balance $11 monthly for 5 months.

Please rush the instruments checked for a 10 day free trial. If satisfied I agree to pay the down payment within 10 days and the monthly installments as shown. If not completely satisfied I will return the instruments within 10 days and there is no further obligation. It is understood there will be NO INTEREST or FINANCING charges added.

Name .....

Please print clearly

Address .....

ELIMINATE FM AUTO RADIO INTERFERENCE

Ignition noise can destroy the advantages of FM radio—and a few simple tricks can eliminate ignition noise

By LARRY STECKLER
ASSOCIATE EDITOR

THE FM radio has often proved superior to AM when it comes to noise-free listening and full-frequency response. And now that you can put an FM set in your car (see photo), no matter where you go, pleasing high-fidelity music can be yours to listen to. But auto radio, FM or AM, brings with it a new set of problems, things that didn't exist when you kept your radio at home.

FM broadcasting (88–108-mc) uses a part of the vhf band and its characteristics are similar to those of TV frequencies. Under normal atmospheric conditions these waves travel in straight lines and reception is limited by the earth's curvature. A mountain or other large object may block the reception path. So from time to time you may find yourself in an "FM dead area" and unable to receive an FM signal.

Something else to contend with is the way an FM signal can be reflected by metal buildings, hills and power lines. Often, the signal arriving at the FM receiver is a mixture of the signal direct from the transmitter and one or more reflected waves. In the home receiver, located in a fixed position, this usually has no noticeable effect. But when you put the receiver in a moving vehicle this is no longer true.

When a car carrying an FM receiver is driven along a highway, the direct and reflected waves aid and cancel each other and the signal picked up has a rapid flutter. With a strong signal, it is not noticeable, as the limiter stages keep the receiver from reacting to these changes in signal strength. But in fringe areas, where signals are weak, the flutter can be heard and is annoying.

To reduce flutter caused by weak signals some special automotive FM antennas have been developed. Gonset makes a hoop (see photo) that fits over the standard antenna and is said to increase signal strength in fringe areas from 50% to 100%. So if FM reception in your car is not satisfactory, because of excessive flutter, try one of them. You will be surprised at the difference.

When you use your standard whip antenna for FM reception, remember a couple of points. First, keep the coax connecting the antenna to the set as short as possible. Rear-fender and rear-deck antennas usually are not satisfactory for FM reception as they cannot deliver enough signal through the long antenna lead. Another type of standard antenna that usually does not work too well for FM is the automatic unit that is normally recessed into a well into the car's fender. This well is usually just the right size to act as a trap and does not let the FM signal come through to the set. In both instances, the only cure

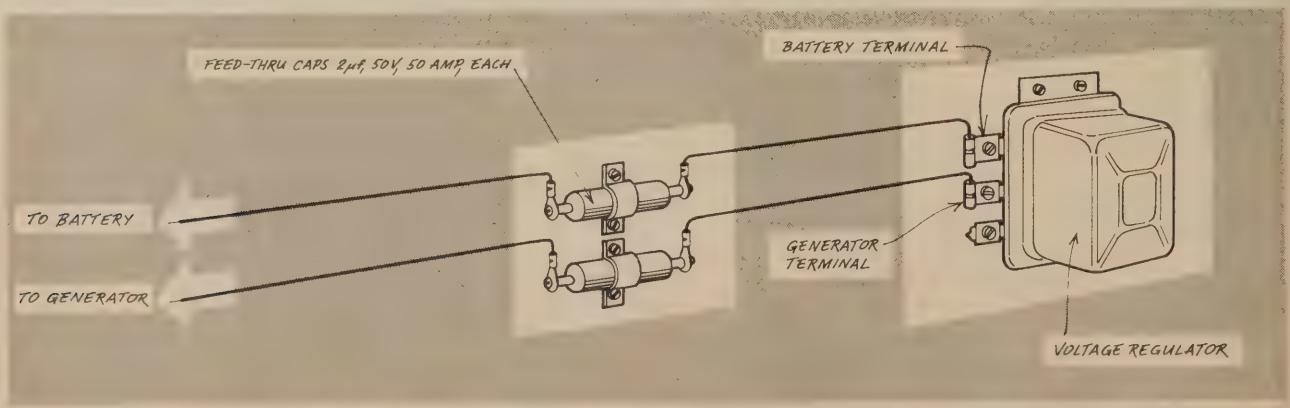


Fig. 1—Coaxial capacitors on the voltage-regulator leads stops the popping often caused by arcing breaker contacts. Although the drawing shows some lead length, leads must be short and the capacitors mounted as near the voltage regulator as possible.

is to use a standard whip on a front fender. As a last point, remember that your whip is not designed for FM frequencies so it should not be used all the way up or all the way down. Instead, extend it to about 30 inches. This will give the best possible results.

One of the first advantages you will notice after putting an FM receiver in your car is how the FM program rarely dies out, even when going over bridges or through underpasses. Then, too, FM in your car retains its most important advantage, freedom from the man-made noises produced by power lines, neon signs, street cars and most other sources of interference. But your own

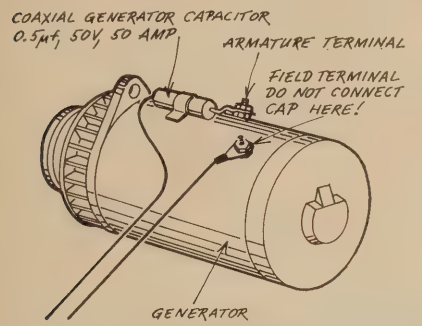


Fig. 2—Generator whine can be licked with a coaxial bypass capacitor.

car my produce enough interference to ruin reception.

Occasionally, when you put an FM receiver in a car, a considerable amount of noise is heard whenever the motor is running. Should this happen to you, there are a few things that need checking. The best place to start is at the antenna. (Incidentally, the following tips are also considerations when trying to get rid of interference in AM auto sets.)

Antenna troubles

The most common antenna fault is an improper ground. An auto antenna is usually grounded by a serrated washer which digs into the metal body of the car. If the washer is loose or if the car has an undercoating, the ground contact may be poor. For a loose washer, tighten the nut that holds it in place. A deep socket wrench is needed to do this job right. Space is at a premium and almost no other type of wrench will let you apply enough pressure to tighten the nut fully. If undercoating is the problem, loosen the antenna mounting nut, scrape the area contacted by the washer until it is bright and shiny, and retighten the nut.

Ignition interference

The car's electrical system is another common cause of interference. Spark plugs, the distributor, the generator and even the voltage regulator can be at fault. The best way to tell which component is making trouble is to carefully analyze the type of interference you hear. It usually breaks down into one of three types:

- A popping noise from the speaker which increases to loud buzz as engine speed increases.
- A whine which appears as engine speed increases.
- Erratic popping which changes only slightly in frequency with increases in engine speed.

The popping noise can be caused by spark plugs or the voltage regulator. When the plugs are at fault the popping turns into a buzz if you race the engine. If it's caused by the generator, the popping will be erratic and will change only slightly with changes in engine speed. If the trouble is in the spark plugs, replace them with resistor type plugs or use resistor cable between the plugs and the distributor. (Both are available either from Auto-Lite dealers or from the larger automotive parts shops.)

When the popping is caused by the regulator, it is usually the vibrating breaker contacts in the unit that are arcing. The solution is to use a coaxial capacitor between the battery terminal of the regulator and the battery lead —about a 2-μf unit should do the job (Cornell Dubilier NF-10270-1. These are rather expensive units and usually require a special order by your distributor to get them.). Its current rating should be around 50 amps. A similar capacitor should be placed between the

"ONE DOLLAR" buys

As much as $15 worth—Everything Brand New and sold to you with a money back guarantee.

DEDUCT 10% ON ANY ORDER OF $10 OR OVER—Plus a FREE SURPRISE PACKAGE

- ☐ 1—3" PM SPEAKER alnico ⌀5 magnet $1
- ☐ 1—4" PM SPEAKER alnico ⌀5 magnet $1
- ☐ 1—5" PM SPEAKER 3½ alnico ⌀5 magnet $1
- ☐ 1—3½" TWEETER SPEAKER for Hi-Fi $1
- ☐ 3—AUDIO OUTPUT TRANS. 50L6 type $1
- ☐ 3—AUDIO OUTPUT TRANS. 6K6 or 6V6 $1
- ☐ 2—AUDIO OUTPUT TRANS. 6K6 push-pull $1
- ☐ 2—AUDIO OUTPUT TRANS. 6L6 type $1
- ☐ 2—CHOKE TRANS. 52Ω for Radio or TV $1
- ☐ 3—I.F. COIL TRANSFORMERS 456 kc $1
- ☐ 3—I.F. COIL TRANSFORMERS 10.7 mc FM $1
- ☐ 3—I.F. COIL TRANSFORMERS 262kc(auto) $1
- ☐ 4—OVAL LOOP ANTENNA set's hi-gain $1
- ☐ 3—LOOPSTICK ANT. latest type adjustable $1
- ☐ 3—VARIABLE COND. super 420/162 mfd $1
- ☐ 3—ASST. SIZES RADIO CHASSIS PANS $1
- ☐ 12—RADIO OSCILLATOR COILS 456 kc $1
- ☐ 3—½ MEG. VOLUME CONTROLS w/switch $1
- ☐ 5—½ MEG. VOLUME CONTROLS 1/switch $1
- ☐ 5—50K VOLUME CONTROLS less switch $1
- ☐ 5—ASS'T. 4 WATT WIREW'D CONTROLS $1
- ☐ 10—ASST. VOLUME CONTROLS less switch $1
- ☐ 5—ASST. VOLUME CONTROLS w/switch $1
- ☐ 100—VOLUME CONTROL HEX NUTS $1
- ☐ 10—SURE GRIP ALLIGATOR CLIPS $1
- ☐ 1—GOLD GRILLE CLOTH 14x14or12x18 $1
- ☐ 5—SETS SPEAKER PLUGS wired $1
- ☐ 10—SETS PHONO PLUGS and PINJACKS $1
- ☐ 2—$2.50 SAPPHIRE NEEDLES 5000 plays $1
- ☐ 20—ASST. PILOT LIGHTS popular types $1
- ☐ 10—PILOT LT. SKTS. bayonet type, wired $1
- ☐ 50—ASST. TERMINAL STRIPS 1, 2, 3, 4 lug $1
- ☐ 20—ASSORTED TUBE SHIELDS best sizes $1
- ☐ 35—ASST. RADIO KNOBS. screw & push $1
- ☐ 75—KNOB SPRINGS standard ¾" to 1½" $1
- ☐ 100—ASSORTED KNOB SET-SCREWS $1
- ☐ 25—ASS'TED RADIO DIAL POINTERS $1
- ☐ 25—ASS'TED CLOCK RADIO KNOBS $1
- ☐ 15—ASST. ROTARY SWITCHES $15 worth $1
- ☐ 3—TOGGLE SWITCHES spst, dpdt, etc. $1
- ☐ 6—SLIDE SWITCHES spst, dpdt, etc. $1
- ☐ 4—BAKELITE KNIFE SWITCHES dpdt $1
- ☐ 35—ASST. SOCKETS octal, nov. & m'ature $1
- ☐ 100—ASST. ½ WATT RESISTORS some 5% $1
- ☐ 70—ASS'TED 1 WATT RESISTORS some 5% $1
- ☐ 35—ASS'TED 2 WATT RESISTORS some 5% $1
- ☐ 25—ASST. PRINTED CIRCUIT SOCKETS $1
- ☐ 50—ASST. TUBULAR CONDENSERS $1
- ☐ 20—TUBULAR CONDENSERS .047-600v $1
- ☐ 15—TUBULAR CONDENSERS .47-600v $1
- ☐ 20-TUBULAR CONDENSERS .001-1000v $1
- ☐ 20—TUBULAR CONDENSERS .005-600v $1
- ☐ 20—TUBULAR CONDENSERS .01-600v $1
- ☐ 15—TUBULAR CONDENSERS .1-600v $1
- ☐ 15—TUBULAR CONDENSERS .25-600v $1
- ☐ 10—HV TUB. CONDENSERS .007-1600v $1
- ☐ 10—HV TUB. CONDENSERS .001-6000v $1
- ☐ 10—HV TUB. CONDENSERS .005-3000v $1
- ☐ 10—ASST. RADIO ELECTROLYTIC COND $1
- ☐ 5—ASST. TV ELECTROLYTIC COND. $1
- ☐ 2—ELECTROLYTIC CONDENSERS 40-450v $1
- ☐ 3-ELECTROLYTIC COND. 16/16-450v $1
- ☐ 3—ELECTROLYTIC COND. 80-450v $1
- ☐ 3—ELECTROLYTIC COND. 50/30-150v $1
- ☐ 30—FP CONDENSER MOUNTING WAFERS $1
- ☐ 6—TUBULAR ELECT. CONDENSERS 1-50v $1
- ☐ 6—TUBULAR ELECT. CONDENSERS 2-450v $1
- ☐ 6—TUBULAR ELECT. CONDENSERS 8-150v $1
- ☐ 50—ASSORTED FUSES popular sizes $1
- ☐ 50—150Ω ½ WATT RESISTORS 10% $1
- ☐ 50—100KΩ ½ WATT RESISTORS 5% $1
- ☐ 50—470KΩ ½ WATT RESISTORS 10% $1
- ☐ 50—2.2 MEGΩ ½ W. RESISTORS 10% $1
- ☐ 10—ASST. WIREW'ND RES. 5, 10, 20 watt $1
- ☐ 40—ASST. PRECISION RESISTORS best sizes $1
- ☐ 35—ASST. DISC CERAMICS best numbers $1
- ☐ 35—DISC CERAMICS 5000 mmf $1
- ☐ 25—ASSORTED MICA TRIMMER COND. $1
- ☐ 10—6' ELECTRIC LINE CORDS w/plugs $1
- ☐ 5—TV CHEATER CORDS w/both plugs $1
- ☐ 4—50' SPOOLS HOOK-UP WIRE 4 colors $1
- ☐ 50—STRIPS ASS'TED SPAGHETTI best sizes $1
- ☐ 100—ASST. RUBBER GROMMETS best sizes $1
- ☐ 25'—SPONGE RUBBER 1¼"x¼" many uses $1
- ☐ 100'—TWIN LEAD-IN WIRE 300Ω heav.duty $1
- ☐ 50'—FLAT 4-COND. WIRE many purposes $1
- ☐ $15—"JACKPOT" TELEVISION PARTS $1
- ☐ 25'—INSULATED SHIELDED WIRE $1
- ☐ 75' MINIATURE ZIP CORD 2 conductor $1
- ☐ 32' TEST PROD. WIRE deluxe (red or black) $1
- ☐ 100'—FINEST NYLON DIAL CORD best size $1
- ☐ 1—$7 INDOOR TV ANT. hi-gain 3 sec. $1
- ☐ 1—RCA 70° FLYBACK TRANS. 75240 $1
- ☐ 1—90° FLYBACK TRANS incl. schematic $1
- ☐ 1—$11 TODD 60° DEFLECTION YOKE $1
- ☐ 8—DEFLECTION YOKE MOUNTING HOODS $1
- ☐ 4—TV CENTERING RINGS for back of yoke $1
- ☐ 4—TV CENTERING RINGS fits on neck CRT $1
- ☐ 15—ASST. TV COILS sync, peaking, width $1
- ☐ 5—TV CRT. SOCKETS with 18" leads $1
- ☐ 5—HI-VOLT. ANODE LEADS with 18" leads $1
- ☐ 10—TV CARTWHEEL CONDENSERS 10kv $1
- ☐ 3—TV CARTWHEEL CONDENSERS 20 kv $1
- ☐ 2—TV CARTWHEEL CONDENSERS 30kv $1
- ☐ 3—HV RECTIFIER SOCKETS 1B3 m'nted $1
- ☐ 3—HV RECTIFIER SOCKETS 1X2 m'nted $1
- ☐ 20—ASST. TV KNOBS, ESCUTCHEONS, etc. $1
- ☐ 15—ASST. STANDARD TUNER VHF STRIPS $1
- ☐ 6—ASST. UHF STANDARD TUNER STRIPS $1
- ☐ 25—ASST. PEAKING COILS popular types $1
- ☐ 1—RCA SYNCHROGUIDE COIL ⌀205R1 $1
- ☐ 1—RCA SYNCHROLOCOIL ⌀208T8 $1
- ☐ 1—STANDARD AGC COIL 1R4AG $1
- ☐ 1—RATIO DETECTOR COIL 4.5 mc $1
- ☐ 1—RATIO DETECTOR COIL 10.7 mc $1
- ☐ 1—TV VERTICAL OUTPUT TRANSFORMER 10 to 1 ratio $1
- ☐ 1—VERTICAL BLOCK. TRANS. standard $1
- ☐ 6—TV ION TRAPS good for all TV's $1
- ☐ 1—TV FOCUS COIL 270 ohms $1
- ☐ 1—TV FOCUS COIL 330 ohms $1
- ☐ 1—TV FOCUS COIL 470 ohms $1
- ☐ 1—TV FOCALYZER adjusts any ohmage $1
- ☐ 1—2 MEGOHM RESISTOR 20w for ⌀630 $1
- ☐ 1—SILICON RECTIFIER 750 ma 500v $1
- ☐ 5—DIODE CRYSTALS 2—1N21, 2—1N22 1—1N64 $1
- ☐ 3—DIODE CRYSTALS 1—1N60, 1—1N64; 1—1N69 $1
- ☐ 2—SELENIUM RECT. 1—65 ma & 1—250ma $1
- ☐ 2—SELENIUM RECT. 1—75ma & 1—150 ma $1
- ☐ 2—SELENIUM RECTIFIER 100 ma $1
- ☐ 1—SELENIUM RECTIFIERS 450 ma $1
- ☐ 1—SELENIUM RECTIFIER 350ma $1
- ☐ 1—SILICON RECTI. Audio Dev. ⌀40E5 $1
- ☐ 1—70° FLYBACK TRANS. incl. schem'c $1
- ☐ 4—RCA 1U4 TUBES also serves as a 1T4 $1
- ☐ 2—KENRAD 6SH7 TUBES $1
- ☐ 3—RCA 6C4 TUBES $1
- ☐ 2—GENERAL ELEC. 35W4 TUBES $1

TOP BRAND TUBES—1B3, 1X2B, 0Z4, 5U4, 6SN7, 6C86, 6U8, 6J6, 6V6, 6K6, 6X8, 6AX4, 6AC7, 12AU7 Each $1

- ☐ 50—ASST. MICA CONDENSERS some in 5% $1
- ☐ 50—ASST. CERAMIC COND. some in 5% $1
- ☐ 35—MICA COND. 20-5mmf & 15-25 mmf $1
- ☐ 35—MICA COND. 20-50 mmf & 15-68mmf $1
- ☐ 35—MICA COND. 20-100mmf, 15-270mmf $1
- ☐ 35—MICA COND. 20-470mmf, 15-680mmf $1
- ☐ 35—MICA COND. 20-820mmf 15-1000mmf $1
- ☐ 35—MICA COND. 20-2200, 15-2400mmf $1
- ☐ 35—MICA COND. 20-3300, 15-4700 mmf $1
- ☐ 35—MICA COND. 20-6800, 15-10,000mmf $1
- ☐ 35—CERAMIC COND. 20-5mmf, 15-10mmf $1
- ☐ 35—CERAMIC COND. 20-25mmf, 15-47mmf $1
- ☐ 35—CERAMIC COND. 20-56mmf, 15-82mmf $1
- ☐ 35—CERAMIC COND. 20-100, 15-150 mmf $1
- ☐ 35—CERAMIC COND. 20-270, 15-470 mmf $1
- ☐ 35—CERAMIC COND. 20-1000,15-1500mmf $1
- ☐ 35—CERAMIC COND. 20-2000,15-5000mmf $1
- ☐ 600—ASST. HDWARE screws, nuts, rlv., etc. $1
- ☐ 200—SELF TAPPING SCREWS ⌀8 x ½" $1
- ☐ 300—MACHINE SCREWS 6/32x½" $1
- ☐ 50—WING NUTS 6/32 chrome plated $1
- ☐ 2—ELECTRIC MOTORS 1½ volt. 1001 uses $1
- ☐ 1—LB. SPOOL ROSIN CORE SOLDER 40/60 $1
- ☐ 6—SOCKET WRENCHES 3/16" to 7/16" $1
- ☐ 8—ASST. LUCITE CASES handy for parts $1
- ☐ 100—ASSORTED TUBE CARTONS $1
- ☐ 1—LB. SPOOL ROSIN CORE SOLDER 40/60 $1
- ☐ 3—TV ALIGNMENT TOOLS assortment ⌀1 $1
- ☐ 3—TV ALIGNMENT TOOLS assortment ⌀2 $1
- ☐ 3—TV ALIGNMENT TOOLS assortment ⌀3 $1
- ☐ 3—TV ALIGNMENT TOOLS assortment ⌀4 $1
- ☐ 3—TV ALIGNMENT TOOLS assortment ⌀5 $1

EACH ALIGNMENT TOOL is different & valued at over $1

HANDY WAY TO ORDER—Simply tear out advertisement and pencil mark items wanted (X in square is sufficient), enclose with money order or check. You will receive a new copy of this ad for re-orders.

ON SMALL ORDERS—Include stamps for postage, excess will be refunded. Larger orders shipped express collect.

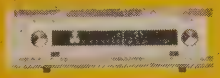
BROOKS RADIO & TV CORP., 84 Vesey St., New York 7, N.Y.

Model S-5000, 20+20W Stereo Dual Amplifier—$189.50

Model S-3000 II, FM Tuner—$105.50

Model S-4400, Stereo Preamp.+36W Amp.—$159.50

Model S-2000 II, FM-AM Tuner—$145.50



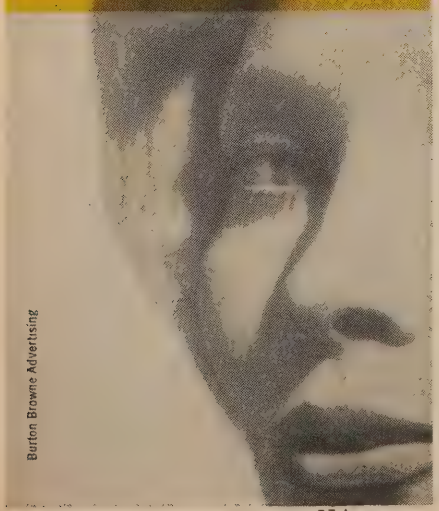
Model S-1000 II, 36W Monaural Amplifier—$109.50

The "complete matching home music center"
—monophonic or stereophonic.

Again another year—recommended by one of the most respected and authoritative Research Testing Organizations as embodying more numerous, more advanced engineering "firsts"—more inherent quality for trouble-free operation—more real value for every dollar than many competitive products selling for more. PLUS: Features that in their unsurpassed engineering win the most discriminating audio-hobbyist; but also features that in their simplicity and ease of operation appeal to everyone—housewife, audio-novice, or just plain music lover. Cabinetry of quiet elegance that blends with any decor. And Sherwood, unmatched at any price, is Fair Trade priced for your assurance that once you have bought Sherwood, you didn't miss a better "deal" someplace else. Sherwood is only for those who want the [illegible]. For further details write: Sherwood Electronic Laboratories, Inc., 4300 N. California Avenue, Chicago 18, Ill.

most honored of them all

SHERWOOD



Button Browne Advertising

FOR COMPLETE SPECIFICATIONS WRITE DEPT. RE-1

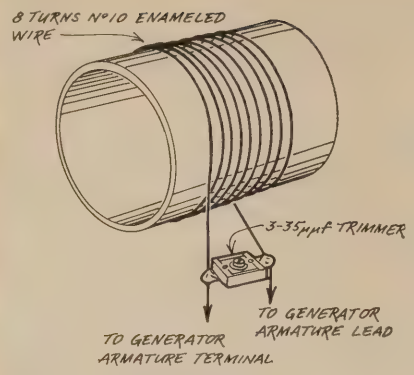
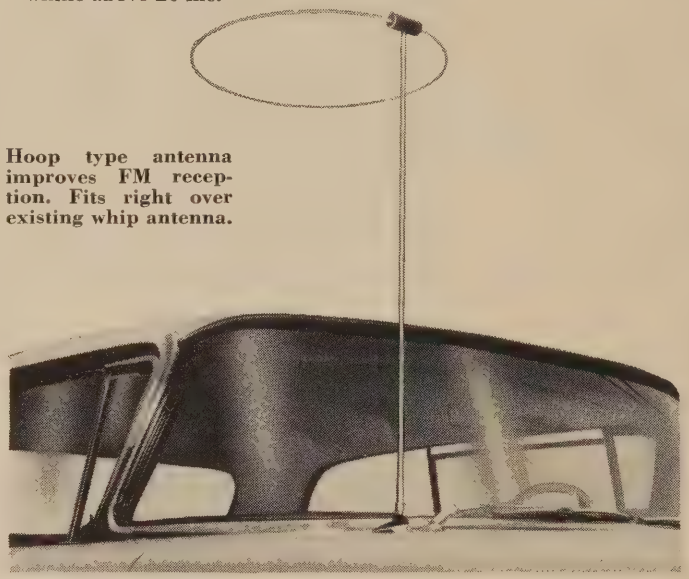


Fig. 3—Simple filter traps out generator whine above 20 mc.



Hoop type antenna improves FM reception. Fits right over existing whip antenna.

regulator's generator terminal and the generator as in Fig. 1. Make sure that the cases of the capacitors are securely grounded—use a braided metal grounding strap if necessary.

When you're up against a variable whine, check the generator. A coaxial 0.5-μf (Sprague 48P18) capacitor with a current rating that exceeds the generator's output should be inserted as shown in Fig. 2. Connect the capacitor case to the generator frame. Use the screw provided for the ground connection to the usual bypass capacitor, which is removed. The lead going to the generator's armature terminal is removed and connected to one end of the coaxial capacitor. The capacitor's other end is connected to the armature cable with a piece of No. 10 wire.

Sometimes, particularly at frequencies above 20 mc (definitely for the FM installer), a series trap is needed to stop generator whine. Such a trap is shown in Fig. 3. It is made from eight turns of No. 10 enameled wire wound on a 1-inch diameter form and shunted with a 3–35-$\mu\mu$f trimmer.

Another source of trouble can be the distributor. Noise originating here is usually caused by loose terminal connections or sparking in the unit.

Check all wiring and, if crimped-on terminals are used at the distributor end of the spark-plug leads, replace them with terminals soldered to the conductor. If sparking in the distributor seems to be the trouble, check the rotor. If it is worn, replace it.

In really persistent cases of interference, connecting all parts of the motor together with a heavy grounding strap is a big help. This means the motor block, generator, battery ground, regulator, distributor, and sometimes even the hood. You'll be surprised how much this can reduce noise.

So if your car is an interference trap, try these few simple suggestions and put yourself on the road to pleasant listening—AM or FM. END

FCC CAUTIONS CITIZENS BANDERS NOT TO RAG-CHEW

The FCC has taken note of excessive air time on the Citizens band for talk other than that authorized. It is cautioning new licensees not to use the Citizens radio service:

As a hobby in itself, as opposed to its use, for example, for controlling model aircraft.

For experimental use with radio on the air. However, it may be used for [*communications* in connection with other] experiments.

For "calling CQ"; that is, attempting to communicate with unknown Citizens radio stations for the sake of making "contacts," including such amateur activities as "directional CQ's" to contact other Citizens radio stations in as many states as possible.

Dx operation; that is, attempting to make long-distance contacts with unknown Citizens radio stations.

Operation of the station as a recreational activity in and of itself, for the pleasure to be derived from such operation.

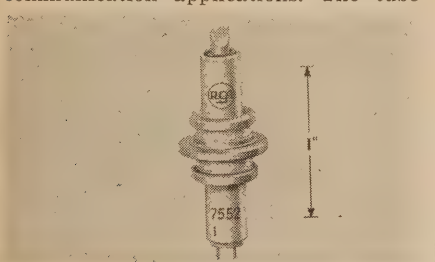
Licensees violating the principles set out above face the possible loss of license and other penalties.

NEW TUBES and SEMICONDUCTORS

A COUPLE of unusual items perk up this month's column—the MS-41 magnetoresistor and the 7552, a pencil-shaped ceramic-metal triode. Other points of interest are a series of tetrodes for vhf TV tuners and a 23-inch picture tube.

7552

A hi-mu triode featuring ceramic–metal construction and space-saving pencil design. It is especially suited to uhf service in portable field equipment, missile-guidance systems and satellite-communication applications. The tube



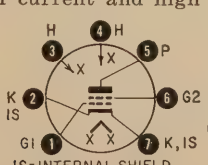
has a maximum plate dissipation of 2.5 watts and can be operated at frequencies up to 1,000 mc and higher. In a typical cathode-drive circuit having a bandwidth of 5 mc and operating at 800 mc, the 7552 has a power gain of 18 db and a noise factor of about 8.5 db. The tube's heater is rated at 6.3 volts at 225 ma.

Characteristics of the RCA 7552 in Class A1 amplifier operation are:

V_P		125
$R_{cathode\ bias}$	(ohms)	50
μ		70
R_P (approx)	(ohms)	4,400
gm	(μmhos)	16,000
I_P	(ma)	14

2EV5, 3EV5, 6EV5

These are high-gain sharp-cutoff 7-pin miniature tetrodes designed particularly for service in vhf TV tuners. Their high transconductance, extremely low screen current and high input impedance at 200 mc results in an improved noise figure.



IS=INTERNAL SHIELD

2EV5
3EV5
6EV5

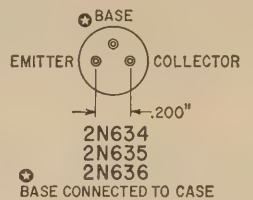
Heater ratings of these tubes are: 2EV5—2.4 volts, 600 ma; 3EV6—2.9 volts, 450 ma; 6EV5—6.3 volts, 200 ma.

Typical operating characteristics of the Westinghouse 'EV5 series are:

V_P		250
V_{G2}		80
V_{G1}		—1
R_P	(k ohms)	150
gm	(μmhos)	8,800
V_{G1}	(cutoff bias for gm of 100 μmhos)	4.5
I_P	(ma)	11.5
I_{G2}	(ma)	0.9

2N634, 635, 636

A series of n-p-n high-frequency computer transistors that feature high-mobility electron flow. They are intend-

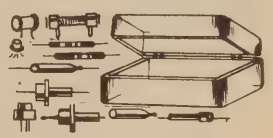


ed for use in switching and flip-flop circuits.

NEW FOR 1960! INTRODUCTORY OFFER

FREE! CHOOSE ANY 2 PAKETTES WITH EVERY 12 PAKETTE ORDER

6 PAKETTE ORDERS—CHOOSE ANY 1 PAKETTE FREE



WHAT IS LEKTRON'S PAKETTE?

It is Lektron's newest method of packaging radio-TV parts assortments in clear, lucite boxes. Each Pakette box features a "snaptop" cover and is easily stackable to fit any shelf or bench, yet your components are always clearly visible. This box alone is worth up to $1.00. You save up to $30 to $35 on parts, too—and get bigger quantities than ever before.

Pick your FREE PAKETTES from this listing! USE AS ORD-A-GRAM

30 "SEALED" CIRCUITS ☐ Built-in resistor coupling networks. Reg. $20. $1

40 MOLDED CONDENSERS ☐ 0.0001 to .1 to 1000 VDC. Oils, porcelain, black beauties. Reg. $30. $1

65 RESISTOR SPECIAL ☐ W.W., & carbon, precision, power, variable, mini. types too. ½W to 50W. Reg. $17. $1

40 POWER RESISTORS ☐ 5 to 50W to 10,000 ohms. Reg. $15. $1

50 TRANSISTOR COND. ☐ Mini. condensers. 0.00025 to 0.1 mf. In 100's of trans. sets. Reg. $7. $1

100 HALF WATTERS ☐ Resistors: carbon. 10 ohms to 2 meg. 10% tol. Pop'lr makers. Reg. $10. $1

15 "GRAIN-O-WHEAT" ☐ Lamps: by G-E. 1.5 VDC. For mini. work. Worth 25c ea. $1

70 MICA CONDENSERS ☐ 0.00025 to .01 to 1000 VDC. "Silvers" too. 20 values. Reg. $13. $1

35 TWO WATTERS ☐ 10 radio & TV values; 100 ohms to 500K. 5% too. Reg. $8. $1

15 ROTARY SWITCHES ☐ 1, 2, 3 gang; long shafts, Pop'lr types. Reg. $15. $1

15 VOLUME CONTROLS ☐ Long & useable shafts. Up to 1 meg. Singles, duals, switch types. Reg. $20. $1

2 SOLAR BATTERIES ☐ Generates power from Sun & "bulb" light. 100's of projects. Reg. $4. $1

20 TWIST DRILLS ☐ 1/16 thru ¼" with calibrated case. For electric drills. Reg. $2.50. $1

24 ARTISTS BRUSHES ☐ 1 to 6 sizes. 100% pure camel hair bristles. $1

40 HI Q CONDENSERS ☐ NPO's, standoff types too. 20 values. Finest porc. prec. quality. Reg. $9. $1

60 TERMINAL STRIPS ☐ Solder lug type; 0.1 to 10 lugs. Used in every elec. proj. $1

525 SURPRISE PAKETTE ☐ Wide variety of radio 'n popular electronic parts. $1

70 TUBULAR CONDENSERS ☐ 20 values 0.0001 to .5 mfd to 1000 VDC. Reg. $10. $1

30 "SILVER" MICAS ☐ 1 & 5%. Asst. values. Finest made. $1

70 INSULATED RESIST'S ☐ Carbon, 1 & 5% too! 10 ohms to 10 meg. 30 values. ½, 1, 2W. Reg. $15. $1

10 RCA PLUG 'N JACK SETS ☐ Matched pairs. For tuners, amps, recorders. $1

300-FT. HOOK-UP WIRE ☐ 16 thru 24. Plastic, glass, insulated. Asst. colors. Tinned. $1

60 RADIO-TV KNOBS ☐ Asst. colors, set screw type too! Plastic ½" to 4" dia. Some $1 ea. $1

50 ONE PERCENT-ERS ☐ Precision carbo-film resistors. Nifty lab case. 15 values. 100 ohms to 1 meg. Reg. $26. $1

60 CONDENSER SPECIAL ☐ Incl. molded, porcelain, oils, electrolytic, mica, disc. Reg. $15. $1

5 ROLLS MICRO-WIRE ☐ #24 to #32. Asst. colors; insulation. Tinned. Reg. $5. $1

1500 PCS HARDWARE ☐ Nuts, bolts, screws, brackets, etc. Handy shop pakette. $1

3 HOBBY TRANSISTORS ☐ For experimental & shop use. Specs unknown. Worth $3 ea. $1

WORLD'S SMALLEST RADIO ☐ Kit. Germanium powered. Lasts for life. Incl. all parts, instructions. $1

12 GERMANIUM DIODES ☐ For radio & TV detectors, limiters, rectifiers. Glass sealed, long leads. $1

125 RESISTORS ☐ Non-insulated, 30 popular values; ½, 1, 2W, 5% too. 10 ohms to 10 megs. Reg. $15. $1

10-IN-1 PAKETTE ☐ Incl. diodes, resistors, electros, sockets, lites, wire, knobs, v-controls, strips, condensers. $1

TRANSISTOR RADIO BASIC ☐ Incl. transistor & socket, diode, loopstick, in handy pakette. $1

2 POWER TRANSISTORS ☐ Handles 10 watts. For audio circuits in cars, etc. Worth $10 ea. $1

2 SILICON RECTIFIERS ☐ 500 mil. Axial leads. Size of 1W resistor. Reg. $3 ea. $1

8-PC. NUTDRIVER SET ☐ Molded, lucite handle. Steel socket wrenches. 3/16, 7/32, ¼, 5/16, 11/32, 7/16". In carry case. $1

10 PANEL SWITCHES ☐ 115 VAC, micro, slide, etc. Some worth $1.50 ea. $1

4 OUTPUT XFMRS ☐ 50L6, 6V6, 6K6, etc. Open frame types. Some worth $2.50 ea. $1

2 FLEA POWER MOTORS ☐ 1½ VDC. Powerful. 100's of control uses. $1

40 TUBE SOCKETS ☐ 4, 5, 6, 7, 8, 9 pins. Octals, mini types. Some shield, mica, ceramic. Reg. $10. $1

30 PILOT LITES ☐ Mini bay, & screw types. "Grain 'o wheat" too. 1.5 to 6V. $1

40 DISC CONDENSERS ☐ Incl. world's tiniest; only ¼" x 10mmf to 1000 VDC. $1

15 "POLY PAKETTES" ☐ Incl. poly boxes, vials, asst, sizes. For radio, TV submini parts. $1

15 ELECTROLYTICS ☐ FF & tubular paper & can types. Single, duals & triple values. 10 to 300 mf to 450 VDC. Reg. $20. $1

100 CERAMIC SPECIAL ☐ Incl. discs, NPO's, molded, tubulars, dog bones. 25 values. $1

75 ONE WATTERS ☐ Resistors incl. 1 & 5% carbons. 20 popular values. Reg. $18. $1

2 POSTAGE STAMP MIKE ☐ Crystal. By Brush. 1" sq. Nifty, hide-away unit. 100 to 7000 cps response. $1

7 SILICON DIODES ☐ Used in gov't & "space" work. 1N21; 1N22, etc. Worth $10 ea. $1

70 COILS & CHOKES ☐ RF, ant, osc., slug-tuned, & IF styles. 15 types. Reg. $22. $1

60 PLUGS & REC'T'LS ☐ Power, battery, audio; 15 types. $1

15 POLY VIALS ☐ For stocking submini & transistor parts, E-Z to see, to read, to "stack." Asst. sizes. $1

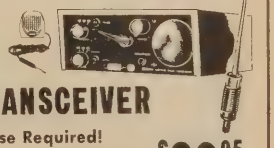
CRYSTAL PHONE ☐ Use as mike too! W/cord & plug set. Hearing aid type. 100 to 6000 cps resp. $1

Due to the large physical size of a few assortments, polypaks are used

FREE! WRITE FOR GIANT BARGAIN CATALOG— Year's Subscription

CIVIL DEFENSE! BUSINESS! DOCTORS! HOMES! FARMS! BOATS! TAXIS!

PHILMORE CITIZENS' BAND 2-WAY TRANSCEIVER



- No FCC License Required!
- No Tests or Code to Learn!
- Anyone Can Get License!

$39.95 KIT

Easy-to-build, step-by-step pictorials designed by world's finest engineers. Crystal controlled, up to 10 miles distance; 5-watt output, 22-channels for xmtr & rcvr. Includes all parts, mike, crystal, cabinet. 12 lbs. TC11 for 115VAC, $39.95 (TC612 for 6 & 12VDC, $44.49) TC15 whip atenna, $4.50.

Include check or M.O. with sufficient postage; excess returned. C.O.D. orders, 25% down; rated, net 30 days. INCLUDE POSTAL ZONE in address. (Canada postage, 48c 1st lb.; 28c ea. additional lb.)

My FREE PAKETTES are:

1. .....

2. .....

- Check each item wanted
- Return ad with order
- Pakette wt. 1 lb. avg.
- Ea. Pakette guaranteed.

LEKTRON 131 Everett Ave. CHELSEA 50, MASS.

Increase your servicing income with your VOM

The **VOM** is the service technician's "good right arm." Yet how many know all they should about it — what it is, how and why it works, how to get more "mileage" out of it? This book, **How To Get The Most Out of Your VOM**, tells you all — how to make the VOM work for you in new, different and more efficient ways in servicing and construction, how to take care of it, how to repair it, how to check it. Describes commercial units and kits, tells you how to build your own. Outlines what the VOM can do — and what it can't. Tells you which one is best for you. Here's a book that will show up in dollars and cents on your balance sheet by teaching you new skills, showing you new tricks with the VOM. Get it today and see how much there is about the VOM that you never knew before. Watch how it will help you on your next servicing job.

YOU CAN GET THIS $4.60 BOOK FOR ONLY $3.35

This brand-new book in a new beautifully designed hard-cover edition is sold nationally for $4.60. But through the G/L TECHNICIANS' BOOK CLUB you can get it and others equally valuable for only $3.35.

THE G/L TECHNICIANS' BOOK CLUB

has helped thousands of service technicians everywhere

- *Learn More*
- *Do Faster Servicing*
- *Earn More Money*
- *Save money on the books they need to get ahead.*

Here's how it can help you!

This unique club offers deluxe hard-cover editions of today's best practical servicing and theory books by well known authors AT A DISCOUNT OF 27%! Through mass printing and direct distribution we can offer you these $4.60 books AT THE WHOLESALE PRICE OF $3.35 — and we pay the postage!

How the Club Works

- To enroll, select the book you want on the coupon below. SEND NO MONEY. Please select only one book! The one you choose will be sent to you on a No-Risk 10-day inspection plan.
- If you like the book keep it and send us your remittance. If you don't just send it back.
- A new book is published every three months—you receive your personal copy on the same No-Risk inspection plan as soon as it comes off the press.
- Keep only the books you want—pay only for those you keep
- You agree to take a minimum of only 4 books—over the whole enrollment period. You may cancel anytime after that. No time limit — no contract to sign.

If you prefer—select any one of these books

Printed Circuits—*By Morris Moses.*
Servicing Transistor Radios—*by Leonard D'Airo.*
Oscilloscope Techniques—*By Alfred Haas.*
TV and Radio Tube Troubles—*By Sol Heller.*
Rapid TV Repair—*By G. Warren Heath.*
Servicing Color TV—*By Robert G. Middleton.*
TV—It's a Cinch—*By E. Aisberg.*
Servicing Record Changers—*By Harry Mileaf.*
Sweep and Marker Generators for Television and Radio—*By Robert G. Middleton.*
The Oscilloscope—*By George Zwick.*

SEND NO MONEY! MAIL THIS COUPON TODAY!

You have nothing to lose — everything to gain! Examine the books at our risk.

Stay ahead in servicing—keep up with the new techniques, circuits, devices. New books on timely topics now in preparation.

SEND IN THIS COUPON TODAY

GERNSBACK LIBRARY, INC., Dept. 10C
154 West 14th St., New York 11, N. Y.

Enroll me in the G/L TECHNICIANS' BOOK CLUB. Begin my membership with the book checked below. Please check one only.

- ☐ HOW TO GET THE MOST OUT OF YOUR VOM
- ☐ PRINTED CIRCUITS
- ☐ RAPID RADIO REPAIR
- ☐ SERVICING TRANSISTOR RADIOS
- ☐ OSCILLOSCOPE TECHNIQUES
- ☐ TV and RADIO TUBE TROUBLES
- ☐ RAPID TV REPAIR
- ☐ SERVICING COLOR TV
- ☐ TV—IT'S A CINCH
- ☐ SWEEP AND MARKER GENERATORS
- ☐ SERVICING RECORD CHANGERS
- ☐ THE OSCILLOSCOPE

Name..... (please print)
Street. .....
City..... .....Zone....State.....

NEW TUBES & SEMICONDUCTORS *(Cont'd)*

Maximum ratings of these CBS transistors at 25°C are:

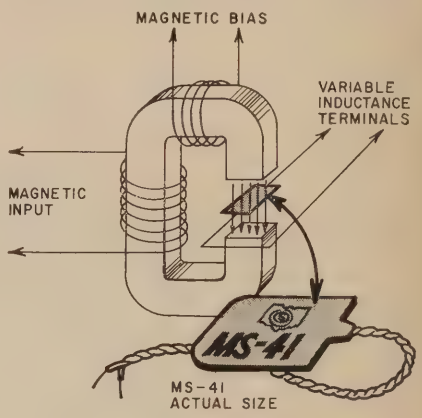
V_{CB}	20
V_{CE}	20
V_{EB}	15
P_{total} (mw)	150

Electrical characteristics at 25°C are:

	2N634	2N635	2N636
I_{CBO} (μa)			
(V_{CB}=5)	5	5	5
(V_{CB}=20)	15	15	15
I_{EBO} (μa)			
(V_{EB}=15)	10	10	10
V_{CEO}			
(I_C=600 μa, R_{BE}=10 k)	20	20	15
h_{FE}			
(I_C=200 ma, V_{CE}=0.75)	15	25	35
$f\alpha_b$			
(I_E=1 ma, V_{CB}=5)	5	10	15

MS-41 magnetoresistor

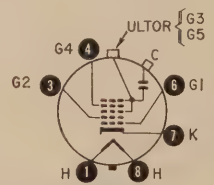
A solid-state device in which the electrical resistance is a function of an applied magnetic-field density. The



Ohio Semiconductors MS-41 uses a thin wafer of indium antimonide and has a high-field to zero-field ratio of 10 to 1 at 10 kilogauss. The MS-41 can be used in voltage-regulator, transducer, power amplifier and measuring circuits.

23KP4

A square-cornered picture tube which does not have an attached safety glass. The tube has 114° deflection but uses standard 110° sweep components. No ion trap is required and the tube is elec-



23KP4

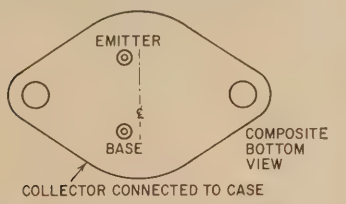
trostatically focused and magnetically deflected. Its screen is aluminized and has a conductive coating.

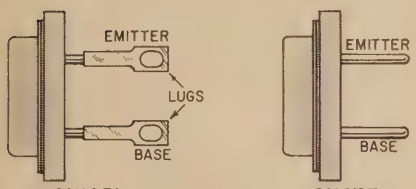
Design maximum ratings of the G-E 23KP4 are:

V_{ultor}	20,000
(minimum)	15,000
V_{G4}	−500 to +1,000
V_{G2}	700
(minimum)	400
V_{G1} (max neg)	140
(max neg peak)	200
(max pos)	0
(max pos peak)	2

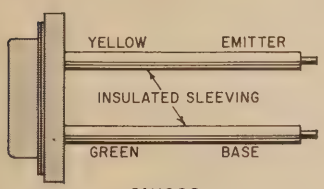
2N1031, 2N1029, 2N677

These power transistors have a typical current gain of 40 at 10 amps and a maximum current rating of 15 amps. They are designed as high-current switching transistors for dc–dc converter and dc–ac inverter circuits. These





2N1031 2N677



2N1029

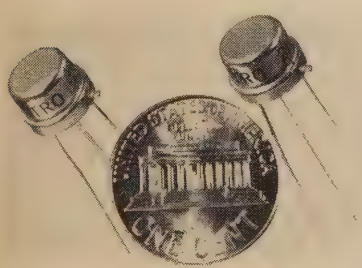
transistors can switch up to 1,000 watts, and have other applications such as power supply regulators, magnetic clutches, relay replacements, power amplifiers, motor control, etc.

Maximum ratings of these Bendix transistors are:

V_{CE}	30
V_{CB}	50
I_C (peak) (amps)	25
(average amps)	15
P_C (watts)	50
I_B (amps)	1.5

Semiconductor briefs

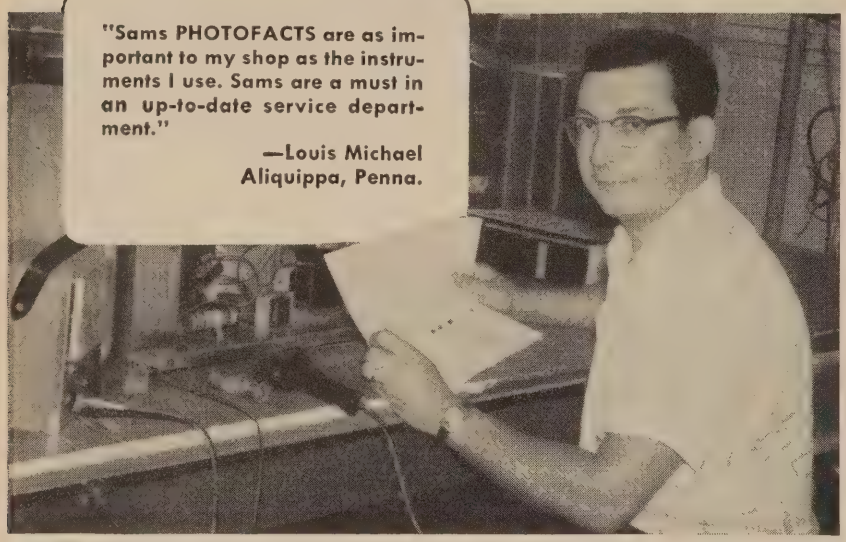
Industro Transistor Corp. announces the 2N1356 an improved, reliable, floating-base replacement for the 2N396-A. All electrical and mechanical specifications are the same as the prototype ex-



cept that all three leads are insulated from the case. In the prototype the base is connected to the case. Also available in this series are the 2N1353, 2N1354, 2N1355 and 2N1357. These are floating-base replacements for the 2N384, 2N395, 2N396 and 2N397, respectively. These transistors are intended for military and industrial computer use. END

CARTOONS
RADIO-ELECTRONICS pays $3.00 for good
cartoon ideas and $15 and up for finished work.
Radio-Electronics
154 West 14th St., New York 11, N. Y.

Service Technicians! YOU EARN MORE... YOU RATE with the public when you own the PHOTOFACT® service data library!


"Sams PHOTOFACTS are as important to my shop as the instruments I use. Sams are a must in an up-to-date service department."
—Louis Michael
Aliquippa, Penna.

YES, if you are one of the thousands of owners of a complete PHOTOFACT Service Data Library, you are enjoying maximum earnings. It's inevitable, because no matter how expert you are, you can always *save more time* on *any* job, get *more* jobs done daily—EARN MORE, DAY IN AND DAY OUT...

Moreover—as the owner of a complete PHOTOFACT Library, *you* know your customers' sets *best*. You can actually show each customer you have the PHOTOFACT Folder covering his very own set. Result: You command public respect and acceptance which paves the way to more business and earnings for you...

HOW TO STAY AHEAD...

Today, the truly successful Service Technicians are those who own the complete PHOTOFACT Library, who can meet and solve any repair problem—faster and more profitably. And these men *keep ahead* because they're on a Standing Order Subscription with their Distributors to receive all new PHOTOFACTS as they are released monthly.

For **PHOTOFACT** Library Easy-Buy Plan details and Standing Order Subscription, see your Sams Distributor today, or write to Howard W. Sams...

"PEET" PROGRAM **BIG NEW PLUS!** *get the details*

If you now own a **PHOTOFACT** Library, you can apply for membership in the powerful new "PEET" program, designed to build prestige and business for the Service Technician who qualifies. Ask your Sams Distributor for the "PEET" details, or mail coupon today!

HOWARD W. SAMS & CO., INC.
1726 E. 38th St., Indianapolis 6, Ind.

☐ Send me full details on the new "PEET" Program. Include full information on the Easy-Buy Plan and Free File Cabinet deal.

☐ I'm a Service Technician: ☐ full-time; ☐ part-time

My Distributor is:_____

Shop Name_____

Attn:_____

Address_____

City_____ Zone____ State_____

TECHNICIANS' NEWS

PART-TIMERS, GOOD AND BAD

"We need a redefinition of 'part-timer' and the real culprit, the 'fringe operator'," says Kurt Wertheim in *Sarta News* (San Antonio, Tex.): "There is a vast difference between the man who runs a service business on a regular but part-time basis, with the intention of going full-time at a later date, and the night-crawler who comes out and uses his talents (?) only to pick up a few extra bucks at the expense of his tax-paying competitors.

"There is also a small minority of full-time shops that are not in commercial locations. I believe that if they have a store license, retailer's permit, bond, and operate under the law, they deserve our help to the end that they can eventually open up in the front-door type shops that they should be in.

"The 'fringe operator' is the guy we're after right now. He's one of the big complaints for several reasons. One is that he fills the set with new tubes before he decides that the repair job is too much for him. The second is that, when he does go into a set to make circuit repairs, before giving up he leaves us with a real headache in putting it back the way it was designed . . ."

(NATESA has defined part-time service technicians. See page 136, November, RADIO-ELECTRONICS. — *Editor*)

ETG HEARS TV REPS

Fall meetings of the Electronic Technicians Guild of Massachusetts, Boston Chapter, were scheduled to hear representatives of General Electric and of Motorola discuss new features of their respective 1969 TV lines at each of two regular monthly meetings.

UTICA TV STATION COOPERATES

When station WKTV, channel 13, Utica, N. Y., changed over to channel 2, the local service technicians' group, MVRTTG (Mohawk Valley Radio-TV Technicians' Guild), got together with the station to run announcements saying, "If you have any difficulty receiving the new channel, call your regular service technician or a member of the MVRTTG for service and adjustment. Call * * * * * and the member of MVRTTG nearest you will handle your call." The Guild handled 75 calls during the first month of this activity.

Subsequently, two more public-service promotions featuring Guild members and officials over the TV station and WKTV's radio station publicized the group. As a result, MVRTTG reports they've been swamped with membership applications. They're planning an adver-

ARE YOU ON THE LIST?

Radio-Electronics is publishing a detailed list of the known television service associations in North America. If you belong to an association that isn't on our list or want to get the name and address of the one closest to you, drop a postcard to: Association Editor, Radio-Electronics, 154 West 14 Street, New York 11, N.Y.

MICHIGAN TELEVISION & ELECTRONIC SERVICE ASSOCIATION, INC.
(MICHIGAN TESA, INC.)
1912 S. Burdick St.
Kalamazoo, Mich.
William West, Jr., Membership Chairman

TESA–LENAWEE
234 W. Church St.
Adrian, Mich.
Howard Merritt

TESA–BATTLE CREEK
988 E. Michigan Ave.
Battle Creek, Mich.
Stanley Rich, president

TESA–FLINT
4437 N. Genesee
Flint, Mich.
William Palmer

TV SERVICE DEALERS ASSN.
49 40th St., S.W.
Grand Rapids, Mich.
Charles LaRoche, president

RADIO-TECHNICIANS ASSN.
702 Mill St.
Kalamazoo, Mich.
Russell Reynolds, president

OAKLAND COUNTY ELECTRONIC ASSN.
770 Orchard Lake
Pontiac, Mich.
Bernard Seiber

S. OAKLAND COUNTY TECHNICIANS ASSN.
3390 W. 12 Mile Rd.
Berkley, Mich.
Mike Mosier

TESA–SAGINAW
3775 N. Michigan
Saginaw, Mich.
John Hooper

ELECTRONIC SERVICE ASSN.
8510 McGraw
Detroit 10, Mich.
Dale Brock, president

TELEVISION SERVICE ASSOCIATION
OF MICHIGAN (TSA OF MICHIGAN)
8225 Woodward
Detroit 27, Mich.
Patrick LaForet, president

tising promotion for the phone-book yellow pages which will list the members of the Guild under its emblem.

TESA MEMBERS CATCH A THIEF

A Midwestern thief who had been posing as a service technician to gain access to shops, then stole equipment and supplies, was caught after his modus operandi was described in the *NATESA Scope* and alert members of TESA-Wisconsin worked together when he showed up in Milwaukee.

When the "con" man came to the shop of TESA member Ed Bruning Ed said he had no work but thought Jerry Hall (chairman, TESA–Wisconsin) might be able to hire him. Then Ed phoned Jerry, who got the police right over. The arrest was made soon after, due to cooperation between the service group members.

NIAGARA FALLS LICENSING

An ordinance licensing TV technicians was passed in Niagara Falls, N. Y., granting licenses for 60 days without examination. Thereafter a three-man board of examiners is to review applicants, who will pay $10 if technicians, $15 if service dealers.

SERVICE CALL $7 IN CALIF.

At a recent meeting of the Radio–TV Association of Santa Clara Valley, it was noted that general practice in that area has been to make a flat charge for service calls up to 30 minutes. One plan was discussed which would set the price at $4.95 to go to the home, and $1.50 each 15 minutes inside.

One member said his prices started at $6, with additional charges depending on distance from his shop. It appeared that most service calls were running $5.50 to $6.50, and included a basic 30 minutes' work in the home at that price.

The discussion wound up with agreement that the RTASCV would recognize $7.50 as a legitimate service-call charge, although individual firms would be allowed to set their own charges still. It appeared, however, that most shop-owners would not exceed $7 for a while, though a number said they would move up to that price at once.

EVILS OF D-I-Y TESTERS

An open letter to the public from the Oakland County (Mich.) Electronics Association details the evils of drug-store tube testers.

"Long before anyone else knew about them (do-it-yourself tube testers) we purchased several . . . because we felt that anything as important as this should meet a certain minimum standard for the protection of the general public. We compared them against the standards of the testers in our shops. They were so far below . . . we refused, for our customers' protection, to have anything to do with them.

"Do-it-yourself checkers are not capable of testing some multi-element tubes, and inaccuracies can be costly . . . only a qualified technician can properly evaluate the testing of a tube . . .

"We have yet to see a tube tester designed accurately enough to provide a thorough check and still be simple enough for the public to operate . . . just because a tube doesn't check quite up to the green mark on a tester is no indication it should be replaced. Some of these tubes will outlast two TV sets. The ones in the critical circuits are sometimes the only ones needing re-

NEW FROM HOWARD W. SAMS

"From Tinfoil to Stereo"

The Evolution of the Phonograph

by Oliver Read & Walter L. Welch

Here is the most complete history of the phonograph ever written—from the use of tinfoil to the revolutionary stereo record—the whole exciting story of the men and events responsible for the development of the phonograph!

You'll be fascinated by this masterful account of the evolution of the phonograph. Covers *everything:* man's earliest dreams of imitating sound; the Edison tinfoil phonograph and the development of the earliest prototypes; the patent struggles; the development of cylinders and discs; the coin-slot phonograph; the introduction of the internal horn; the beginnings of radio and its contribution to recording and reproduction; sound pictures and the phonograph; the war of the record speeds; growth of component systems; tape vs. discs—right down to today. Includes dozens of rare photographs. A wonderful book for every hi-fi enthusiast and phonograph connoisseur. 525 pages, 6 x 9", fully illustrated. Only $9.95

MORE NEW SAMS BOOKS

"101 Ways to Use Your Ham Test Equipment"

by Bob Middleton

A practical "how-to-do-it" book for amateur radio operators and service technicians who specialize in the repair of ham radio equipment. Gives concise applications for grid dip meters, antenna impedance meters, oscilloscopes, bridges, simple noise generators and reflected power meters. Each use is clearly described, with full data on connections required, proper test procedures and evaluation of results. 144 pages; 5½ x 8½"; illustrated. Only $2.00

"Servicing Hi-Fi and FM in the Customer's Home"

by Milton S. Kiver

Describes a wide range of quick, easy test methods for hi-fi amplifiers, AM-FM receivers, record changers, turntables and tape recorders. Includes several unusual new methods, such as the use of an AM detector probe to trace FM circuits. Methods are selected for their quick, practical application and their ability to locate actual and potential trouble spots in hi-fi equipment. Indispensable to anyone interested in servicing hi-fi. 176 pages; 5½ x 8½"; illustrated. Only $2.95

HOWARD W. SAMS & CO., INC.

Order from your Sams Distributor today, or mail to Howard W. Sams & Co., Inc., Dept. A-20 1720 E. 38th St., Indianapolis 6, Ind.

Send me the following books:

☐ "From Tinfoil to Stereo" (EPR-1)
☐ "101 Ways to Use Your Ham Test Equip." (TEM-6)
☐ "Servicing Hi-Fi in the Customer's Home" (SHK-1)
$. . . . . enclosed. ☐ Send Free Book List

Name _____

Address _____

City _____ Zone ____ State _____

(outside U.S.A. priced slightly higher)

PROVED in 3/4-million installations!

AMPHENOL provides both types of TV set couplers—inductive & resistive —to help you serve the growing two set market.

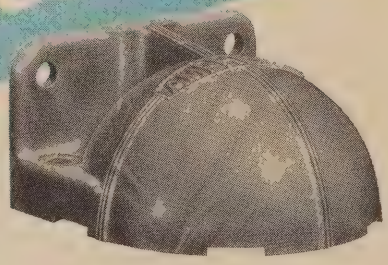
TELECOUPLERS

Improved distributed-line parameter of bifilar-coiled transmission lines isolates the signal and distributes it equally to each set. Near-perfect impedance matching. Low insertion loss. Weatherproof for outdoor or indoor mounting.

TELECOUPLERS

114-088 Two Set	**List $3.75**
114-090 Three or Four Set	**List 5.75**

COLORCOUPLERS



Balanced resistive networks for excellent impedance match, flat signal response, low loss and effective isolation. May be mounted vertically or horizontally. Weatherproof for outdoor or indoor mounting.

COLORCOUPLERS

114-097 Two Set	**List $2.95**
114-098 Three Set	**List 3.95**
114-099 Four Set	**List 4.95**

CONTACT YOUR

Authorized Amphenol Distributor!

AMPHENOL **DISTRIBUTOR DIVISION**

Amphenol-Borg Electronics Corporation

BROADVIEW, ILLINOIS

placement. The do-it-yourself (usually) . . . replaces any tube that isn't quite up to par, hoping a high-voltage tube will cure his audio trouble . . . The net result here is that he buys tubes he doesn't need . . . (and) winds up with the set still not working properly.

"Some new tubes may not check out first-class. You should insist on testing any new tube before purchasing. Be on the lookout for rebranded tubes. Millions have been sold as new. We have found some tubes offered at these (d-i-y tester) locations far out of warranty date, sometimes as much as 5 years.

"You can forget all about these worries simply by making your purchases of new tubes from a local TV service dealer. He buys them from a distributor who has too much at stake to stock out-of-date tubes . . .

"When you need a prescription filled, go to a druggist . . . Likewise, when you have radio or TV trouble go to a TV service dealer."

BBB SUGGESTS

The Seattle, Wash., Better Business Bureau points out that its effectiveness would be greatly increased if its members would report advertisements that contain deceptive, false or misleading statements, or ads not in keeping with good business ethics. The BBB suggests that members finding this sort of advertising telephone or write the bureau giving all details; protest the ad to the newspaper, radio station or other medium publishing it, and call the attention of the local District Attorney to it if the advertising appears to violate any advertising statutes of the state.

PUBLIC RELATIONS ACTION

The Television Service Dealers Association of Grand Rapids has collected 30 used TV sets, put them in good operating condition and delivered them to local children's homes and hospitals.

It was part of a "TV For Tots" program in which TV stations broadcast appeals for the sets and publicized the service group's activity in fixing the sets and placing them with the needy children's institutions.

NEW ARTSNY OFFICERS

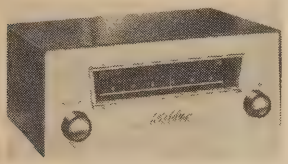
The Associated Radio Television Servicemen of New York, Inc. elected new officers for 1960: Edward Eisen, president; Charles Edwards, vice president; Herbert Schneider, executive secretary; Philip Goldfarb, treasurer. Directors elected for this year were Max Leibowitz, Martin Boxer, Henry Levine, Harold Goodman, Lou Gioia, O. Capitelli, John Wagonny, Fred Rayano, Harold Levinson, Bob Mulwitz and Hyman Brooks.

ARTS (CHICAGO) ELECTS

The Associated Radio & TV Servicemen (ARTS) elected new officers: Joseph Ehlinger, chairman; Harold Mueschen, vice chairman; Yuki Minaga, secretary-treasurer; Delmar Kotrba, sergeant-at-arms. END

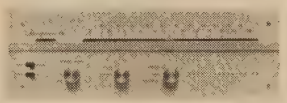
new PRODUCTS

FM TUNER *Model 580* has tuned rf stage, permeability tuning, dual limiters. Afc with afc defeat, cathode-follower output. Sensitivity 1.0 μv for 20-db



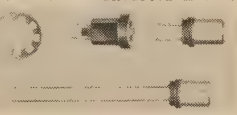
quieting, selectivity 200 kc at 6 db down, distortion under ½% at 2-volt output.—**J. W. Miller Co.**, 5917 S. Main St., Los Angeles, Calif.

FM TUNER *model CT-1*. Dial spread over 10 inches, amplified afc, afc–off switch, interstation muting switch, multiplex socket, 2 independent audio outputs for recorder and amplifier. Sensitivity 1.5 μv (by IHFM stand-



ard) 30-db quieting, image rejection 55 db, capture ratio 1.2/1, output 5 volts, hum and noise down 65 db with 1,000-μv input.—**Karg Laboratories, Inc.**, S. Norwalk, Conn.

SUBMINIATURE FUSE, *Microfuse* precision subminiature unit 0.2051-in diameter x 0.27 in

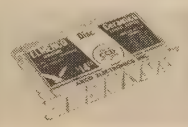


long. From 1/500 to 5 amperes. Blows at 150% in rating m0–10 seconds. Pigtail leads or plug-in, with own holder, shown above.—**Littelfuse Inc.**, Des Plaines, Ill.

HIGH-WATTAGE POTENTIOMETER without size increase is *type 45* wirewound control. 1⅛-in diameter body instead of

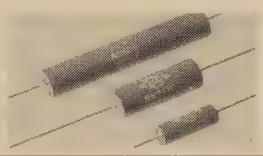
1 23/32-in usually required for 4 watts. Values 1 to 10,000 ohms, one tap only.—**Clarostat Mfg. Co., Inc.**, Dover, N. H.

ELMENCO CAPACITOR KIT *No. 17*. 55 frequently used values, all ±10%, 1,000 volts. Wax-impregnated for extra moisture resistance. Tolerance, capaci-



tance, working voltage printed on units.—**Arco Electronics, Inc.**, 64 White St., New York, N. Y.

PRECISION RESISTORS, molded deposited-carbon *type CPM Carbomold*, moisture- and heat-resistant, encapsulated. ±1%; 10 ohms to 5 megohms ½ watt, 10 ohms to 10 megohms

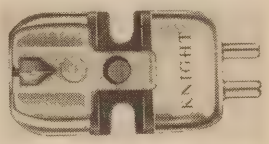


1-watt, 30 ohms to 20 megohms 2-watts. Derated full load at 70°C to zero load at 150°C.—**Hi-Q Div., Aerovox Corp.**, Olean, N. Y.

DISC CERAMIC CAPACITOR line. *Type CCD* 10% tolerance, 1,000 volts. 5–30,000 $\mu\mu$f. *Type 3CCD* 3,000 volts; *type 6CCD* 6,000 volts, both 20%. *Type CCTO*, zero temperature coeffi-

cient 2.2–100 $\mu\mu$f, 1,000 volts. *Type CCTN* 5.0–300 $\mu\mu$f. Packed five capacitors in each plastic box.—**Arco Electronics, Inc.**, 64 White St., New York, N. Y.

STEREO PICKUP *model KN-500*. Low-cost moving magnet cartridge, 0.7-mil radius, diamond readily replaceable. Response 20–20,000 cycles ±3 db,



output 9 millivolts at 10 cm/sec, separation 20 db.—**Allied Radio Corp.**, 100 N. Western Ave., Chicago 80, Ill.

STEREO AMPLIFIER KIT *model KT-236*. 18 watts per channel switchable to 36-watt mono. Dual concentric tone controls, function switch; stereo,

Make Sure

You get every issue of

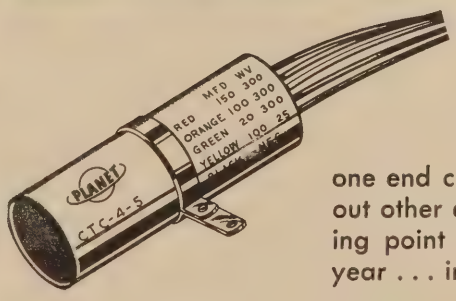
Radio-Electronics

Subscribe now and SAVE

One Year	$4.00
Two Years	$7.00
Three Years	$10.00

Canada same as U. S. Extra postage per year:
Pan-America, 50c; all other foreign, $1.00.

NEW



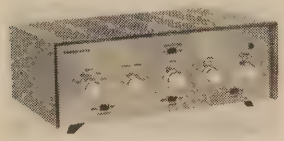
Type "CTC" . . . cardboard tube electrolytics especially designed for exact replacement in television sets . . . one end closed . . . long insulated leads out other end . . . sealed with high melting point wax . . . guaranteed for one year . . . individually packaged.

Write DEPT. R. K. for catalog
Export-Roburn Agencies
New York City

PLANET SALES CORPORATION
225 Belleville Avenue
Bloomfield, N. J.

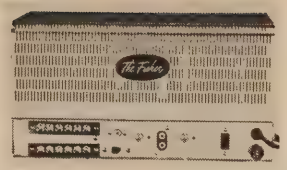
mono, reverse and phase selected by slide switches. Response 15–30,000 cycles ±1 db, sensitivity 3 millivolts (mag phono), hum and noise 70 db down, channel separation 50 db, dual tape outputs.—**Lafayette Radio,** 165-08 Liberty Ave., Jamaica 33, N. Y.

35-WATT STEREO AMPLIFIER *model LA-235* blend control variable from full stereo to monophonic. Concentric clutch volume/balance controls, tone controls. Channel-reverse and



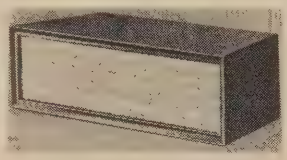
phase-reverse switches. 17.5 watts per channel, distortion under 1%, response 20–20,000 cycles at normal levels, hum and noise 65 db down, channel separation over 40 db, tape outputs. —**Lafayette Radio,** 165-08 Liberty Ave., Jamaica 33, N. Y.

STEREO POWER AMPLIFIER *model SA-100.* 2 power amplifiers, 1 chassis. 25 watts per channel music power rating at 0.8% harmonic distortion. Controls set bias, dc balance, phase-inverter balance, input



levels. Test points and cathode load splitter provided.—**Fisher Radio Corp.** 21-21 44th Drive, Long Island City 1, N. Y.

STEREO REINFORCING SPEAKERS *WS-1* extend radiation of normal stereo system



mid- and high frequencies, 250–15,000 cycles. Connect to any 4-, 8- or 16-ohm taps. Very small (11½ x 3⅞ x 4⅝ in.), finished on all sides in various woods.—**Fisher Radio Corp.,** 21-21, 44th Drive, Long Island City 1, N. Y.

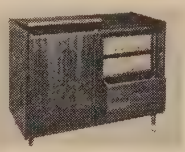
L-PADS for stereo balance

and speaker level control. *Series LL,* two L-pads mounted together, 8, 15 and 50 ohms; *series LA,* 8 and 16 ohms. Include two-faced dial plate with "Balance" on one side, "Level" on other.—**Distributor Div., P. R. Mallory & Co., Inc.,** Box 1558, Indianapolis 6, Ind.

ORGAN KIT *Consolette* smaller than spinet piano, under

38 inches wide, has all keys any organ music requires. Two 61-note keyboards, 22 stops, 13 pedals. $2 demonstration record available; cost refunded with purchase of any kit parts.—**Schober Organ Corp.,** 2248 Broadway, New York 24, N. Y.

EQUIPMENT CABINET *model 105.* Upper-left compartment



with lift top for changer, turntable or tape machine; pullout drawer; sliding doors; removable shelf in upper-right compartment adjustable; blank panel for cutout. Choice of woods.—**Rockford Special Furniture Co.,** 2024 23rd Ave., Rockford, Ill.

PATCH CABLES AND ADAPTERS for audio systems include nine cables with various combinations of plugs plus three adapters. Connectors and plugs molded on, cables waterproof; all contacts, solder points, wire ends imbedded in high-impact plastic.—**Vidaire Electronics Mfg. Corp.,** 44 Church St., Baldwin, N. Y.

COMPONENT LINE includes dual 10- and 20-watt amplifiers, preamplifiers and FM–AM tuner. *Model BM611* (shown) has electron-ray tuning indicator, afc, cathode-follower output, afc-defeat switch, volume control. FM sensitivity 6 μv full limiting, output 2.5 volts for 75-kc deviation, image rejection

33 db. AM sensitivity 20 μv for 100-mv output at 30% modulation, selectivity 3 db down at 5 kc, image rejection 40 db.—**Beam-Echo International, Ltd.,** 820 Greenwich St., New York 14, N. N.

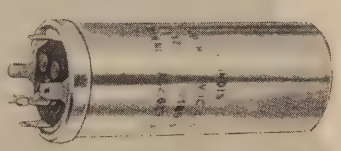
TUNER AND AMPLIFIER KITS *models 20LJK* and *101-GTK* (tuner shown). *20LJK* stereo amplifier, two 10-watt power amplifiers, response ±0.5 db 20–20,000 cycles hum and noise 80 db down. Function, balance, loudness, bass, treble

DOUBLE PROFITS

with these two ILLINOIS "HOT" LINES

Time Tested Quality

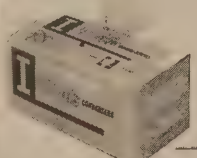
You really make extra profits with ILLINOIS UMP Twist Prong Capacitors which are especially designed for TV replacement. Each capacitor is fully guaranteed for one year . . . and is needed and in demand for replacement use NOW!



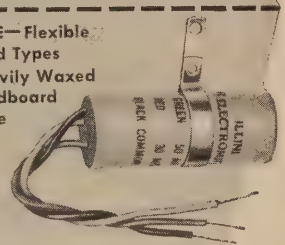
UMP

ELECTROMITE

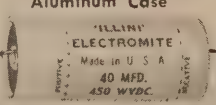
Here are popular, fast moving capacitors which mean repeat business for you. They withstand extreme moisture and temperature conditions. Made of highest quality and unconditionally guaranteed for one year, these attractively-priced capacitors are packaged in eye-appealing boxes.



INTE—Flexible Lead Types Heavily Waxed Cardboard Case



IHCE—Tubular Types Aluminum Case



ILLINOIS "UMP" and "ELECTROMITE" Capacitors are available from leading electronic parts distributors.

Write for our complete catalog.

ILLINOIS CONDENSER COMPANY
1616 NORTH THROOP STREET
CHICAGO 22, ILL. EV 4-1300

Export Department: 15 Moore Street, New York 4, New York

THE BATTERY THAT'S USED IN GUIDED MISSILES NOW RELEASED AS GOVERNMENT SURPLUS

For Photography, Aircraft, Models, Searchlights, Radios, etc.

$1.95 EA. Postpaid

Sintered-plate Nickel-Cadmium alkaline storage batteries designed for "NIKE" Missile and now surplus due to design change. A lifetime battery with no known limit of service (over 5000 recharges on test without loss of capacity). Other features: Virtually indestructible, compact & lightweight, withstands heavy shock and vibration. Flat voltage curve during discharge retains charge year or more, high discharge rate up to 50 amps. for this cell, no corrosive fumes to harm clothing or equipment, spill-proof construction, discharge in any position, indefinite storage without deterioration, operates in temperatures —60° F to +200° F. Each cell is approx. 6 ampere hour capacity. Nominal voltage per cell is 1.2 volts. (A 6 V. battery requires 5 cells.) Cell size 6" H. x 2" W. x ½" T. Wt. 6 oz. ea. Uses Potassium-Hydroxide (30%) electrolyte. Negligible loss during lifetime service. Add only distilled water once a year. A fraction of Government cost.

Used Test Cells.....$1.95 ea. Postpaid
Brand New Cells.....2.95 ea. Postpaid
24 V. Battery, (20 cells in metal case) used $40, new $60.

ALL CELLS GUARANTEED TO YOUR SATISFACTION OR MONEY REFUNDED (LESS POSTAGE).

Plastic battery cases may have slight cracks. Repaired easily with household cement. Or you may add 25¢ to price of each to insure uncracked case.

ESSE RADIO COMPANY, Dept. J-6
42 W. South Street Indianapolis 25, Indiana

Please say you saw it in
RADIO-ELECTRONICS
When answering ads.

LOOK

no further . . . if you're searching for hi-fi savings. Write us your requirements now.

Key Electronics Company
120-A Liberty St., N.Y. 6, N.Y.
Cloverdale 8-4288

your name

—on this coupon—
brings you FREE for
the next 12 months

PRINT YOUR NAME ON THIS COUPON NOW
RADIO SHACK CORPORATION,
Dept. 1E
730 Commonwealth Avenue, Boston 17, Mass.

My name is

Please send FREE Radio Shack Monthly Bargain Catalogs for 1 year

My address _____

City _____ Zone ___ State _____

WORLD-FAMOUS RADIO SHACK MONTHLY BARGAIN CATALOGS

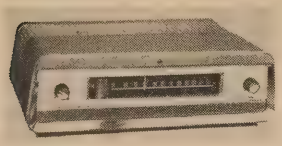
Page after page,
month after month,
a whole year of
America's hottest buys
in hi-fi, records, optics,
"everything electronic".

IN EVERY ISSUE, YOU SAVE DOLLARS ON BEST-SELLERS LIKE THESE:

- 8-transistor portable radio, $29.95
- stereo crystal cartridge, $2.99
- famous 60-pc. train set reduced 60%.
- 15″ $99.95 coaxial speaker, $39.95
- complete stereo tape recorder, $159.95
- reg. $31.98 2-speed blender, $15.99
- famous $60 men's gold watch, $19.99
- 40-watt stereo amplifier, $79.50
- 3-ft. auto antenna, 99c
- famous $4.98 LP disks, $1.99
- $350 stereo lab microscope, $149.95
- 35mm camera, reg. $34.95, $13.97

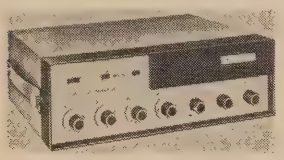
RADIO SHACK CORPORATION

167 WASHINGTON STREET, BOSTON 8, MASS. 730 COMMONWEALTH AVENUE, BOSTON 17, MASS.
230-234 CROWN STREET, NEW HAVEN 10, CONN.



controls. Tuner has tuning eye, afc, two limiters. Both also available wired.—**Grommes Div., Precision Electronics, Inc.,** 9101 King St., Franklin Park, Ill.

30-WATT PUBLIC ADDRESS amplifiers include *Model MX30* (shown). 4 mike inputs (or three mikes and magnetic or crystal phono), 35–20,000 cycles ±2 db. Distortion 1%; output 4, 8, 16 and 163 ohms; balanced 20- and 70-volt taps. *Model M330* similar, only three mike inputs *Model M030* 30-watt



booster amplifier, high impedance and (with transformer) 500-ohm inputs.—**Bogen-Presto Co., Div. of Seigler Corp,** Box 500, Paramus, N. J.

PORTABLE BOOM for microphones extends up to 9 feet

high, 18 feet out; collapses to 5¼ and 7 feet, respectively, in two pieces, for automobile storage. *Model BS-37* deluxe boom has numerous standard and special features for positive positioning, rapid safe adjustment, great flexibility.—**Atlas Sound Corp.,** 1449 39th St., Brooklyn 18, N. Y.

MICROPHONE *model 652* mounted on thin nonreflecting tube uses either of two clear

plastic baffles for 6- or 3-db boost at 6,000 cycles. Output level —60 db. Weighs 11 ounces. —**Electro-Voice, Inc.,** Buchanan, Mich.

RESONANCE LOWERING kit softens cones of loudspeakers. *Flexicone* lowers resonant frequency 10 to 40 cycles. Kit includes brush and three bottles of mixture. Kit does one 15-in, two 12- or four 8-in cones.—**Porter & Dietsch, Inc.,** 2459 University Ave., St. Paul 14, Minn.

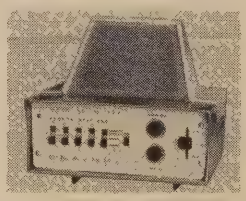
AUDIO MIXER *model VC-220* accepts 2 audio signals; mixes, feeds any high-impedance high- or medium-gain input. Inputs 500,000 ohms, output 500,000 ohms. Input jacks for standard phone plugs and phono plugs.—

Olson Radio Corp., 260 South Forge St., Akron, Ohio.

TURNTABLE-ARM ADJUSTMENT kit includes miniature *Microgram* stylus-pressure gauge and turntable level. Pressure gauge indicates 1 to 10 grams in 1-gram steps.—**Clevite Walco,** 60 Franklin St., East Orange, N. J.

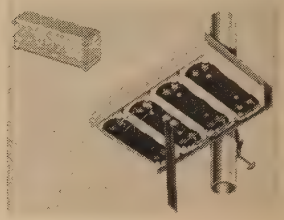
RECORDER CLEANER uses bottle-contained felt applicator to clean tape-recorder heads, capstan pressure rollers and guides. Won't mark or mar plastic parts of machines.—**Chemtronics, Inc.,** 122 Montgomery St., Brooklyn 25, N. Y.

TRANSISTOR INTERCOM KIT *model XI-1* master station calls any combination of 5 remotes. Uses eight ordinary C flashlight cells for 300 hours on. Not used when systems not talking. Remote stations *XIR-1* are 45-ohm 4½-in speakers. Master



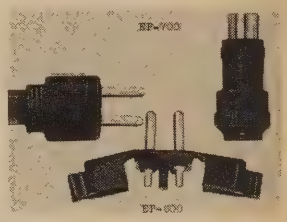
handles up to five remotes.—**Heath Co.,** Benton Harbor, Mich.

ANTENNA MIXING NETWORK *series TX* low-loss, high-isolation units accept signals from up to 9 antennas for

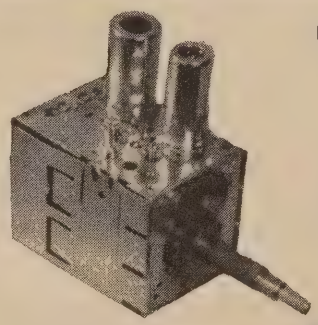


transmission over single lead. *Model TX-FM* combines TV and FM signals.—**Jerrold Electronics Corp.,** 15th and Lehigh Ave., Philadelphia 32, Pa.

MASTER TV CONNECTORS *Tug-Plug* permit plug-in connections without special tools for installation. *EP-600* fits 300-ohm ribbon lead; *EP-700* for



RG-59/U coaxial line.—**Entron, Inc.,** Box 287, Blandensburg, Md.



TV TUNERS
OVERHAULED

VHF OR UHF

ALL MAKES AND MODELS

90 Days Warranty

ALIGNED TO ORIGINAL STANDARDS

VHF OR UHF TUNER OVERHAULED $9.95 NET
UHF/VHF COMBINATION OVERHAULED $19.90 NET

Prices include labor and minor parts only, defective tubes and damaged major parts are extra at net prices.

Forward defective tuner complete with tubes, shield cover and any damaged parts. Quote make and model, and describe fault. We will ship C.O.D.—F.O.B. Chicago or Toronto.

Castle TV Tuner Service

5710 N. Western Ave. Chicago 45, Illinois

Suppliers of rebuilt TV Tuners to leading manufacturers, technicians & service dealers, coast to coast. Original and Only Complete TV Tuner Service covering the North American Continent.

In Canada:—136 MAIN ST., TORONTO 13, ONT.

GET more! DO more! MAKE more!

PROFIT PROFESSIONALLY ON EVERY CALL WITH

NEW B&K LOW-COST PROFESSIONAL Model 550 DYNA-QUIK

DYNAMIC MUTUAL CONDUCTANCE TUBE TESTER

Model 550

NET $119.95

Every service-technician now can easily check tubes the B&K professional way! Only with a *genuine dynamic mutual conductance tube tester* can you make a complete and accurate test under the actual dynamic operating conditions of the TV set. The compact new "550" is not just an emission checker. *It completely checks more tubes faster*—with laboratory accuracy. And the cost is so amazingly low, it pays its way over and over again! Take a tip from thousands of professional servicemen—*use B&K Dyna-Quik*. There is nothing like it.

Get More for Your Money
—IN SPEED, ACCURACY, AND VALUE

Save Customers
—SAVE CALL-BACKS, SAVE COST

Sell More Tubes
—MAKE MORE MONEY PER CALL

MODEL 550 DYNA-QUIK TUBE TESTER

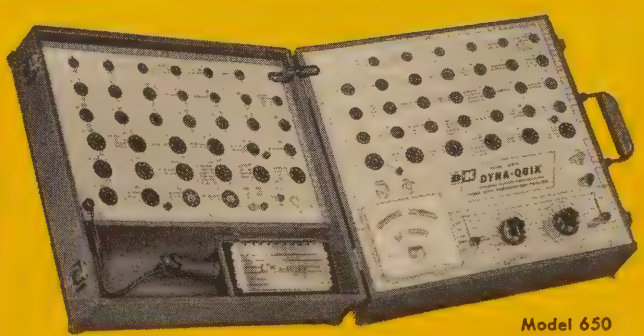
Tests Each Section of Dual-Section Tubes Separately

Great new value in professional quick-check at small cost. Provides **more** tube sockets to test **more** tubes faster. Accurately checks most of the TV and radio tubes usually encountered in everyday service work. Tests each section of dual-section tubes separately. **Measures true dynamic mutual conductance.** Checks tubes for shorts, grid emission, gas content, and leakage. Completely tests each tube in seconds, checks average TV set in a few minutes, in home or shop. One switch tests everything. Fast, convenient reference listings on socket panel. Patented circuit provides automatic line voltage compensation. 7-pin and 9-pin straighteners on panel. Handsome, luggage-type carrying case. Net, **$119.95**

MODEL 650 DELUXE DYNA-QUIK

Today's Finest Portable Tube and Transistor Tester

Accurately checks over 99% of the tubes most widely used in television receivers, plus popular home and portable radio tubes. Tests over 600 tube types. Lists over 125 most popular tube types, with settings, on socket panels for maximum operating speed. Complete listing in fast, index-type selector. **Measures true dynamic mutual conductance.** Tests each section of multiple tubes separately for GM, Shorts, Grid Emission, Gas Content and Life. Includes 16 spare sockets and ample filament voltages for future new tube types. **Transistor Section** checks transistors, diodes, and selenium rectifiers. Luggage-type carrying case. Net, **$169.95**



Model 650

See Your Distributor or Send Now for Bulletin ST24-E

B&K MANUFACTURING CO.
1801 W. BELLE PLAINE AVE • CHICAGO 13, ILL.

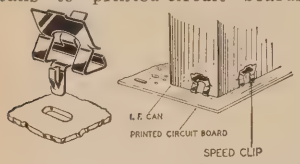
Canada: Atlas Radio Corp., 50 Wingold, Toronto 10, Ont.
Export: Empire Exporters, 277 Broadway, New York 7, U.S.A.

TUBE SAVER is compact unit plugging into wall socket. *TV Life Saver* reduces initial current surge through tube heaters using the *Surgistor* developed by

the company. Two models, for 100–275-watt sets, and for 250–400 watts.—**Wuerth Tube Saver Corp.**, 9125 Livernois Ave., Detroit 4, Mich.

HIGH-STRENGTH ADHESIVE bonds up to 3,000 lbs per square inch. Impervious to water, solvents, temperature changes. Base resin and hardener are mixed just prior to use.—**G-C Electronics Co.**, 400 S. Wyman St., Rockford, Ill.

SPEED CLIP for mounting if cans to printed-circuit boards



requires no tools; makes ground connection also. Removed with simple tool.—**Tinnerman Products, Inc.**, Box 6688, Cleveland 1, Ohio.

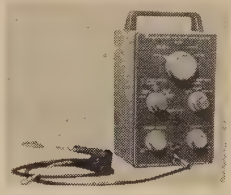
CAPACITOR SUBSTITUTION BOX *model SW-142*. 8-position switch for eight common values

from .001 to 0.25 μf. All capacitors rated at 6,000 volts.—**Olson Radio Corp.**, 260 So. Forge St., Akron, Ohio.

DYNAMIC TRANSISTOR CHECKER model 100 tests wide range of types under circuit conditions, using 1.5-volt battery in checker. NE-51 glows if transistor is good, stays out if bad. Handles and safely identifies n-p-n and p-n-p types. Varying base current with control knob al-

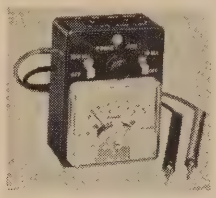
lows matching transistors by noting point at which neon glows. Output jacks for scope or ac meter, clip-on self-storing leads available when use of transistor socket not practical. —SECO Mfg. Co., 5015 Penn Ave. So., Minneapolis, Minn.

FM TEST GENERATOR KIT *model FMO-1* provides output for all rf, if and detector sections of FM sets and tuners. 90, 100 and 107 mc. 400-cycle modulation available; audio also available separately. 10.7-mc



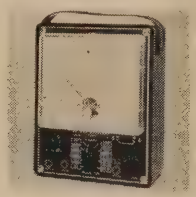
variable sweep width 200-kc to over 1 mc for if alignment. 100-kc markers each side of 10.7 marker. 10-mc crystal-controlled oscillator for calibration.—**Heath Co.**, Benton Harbor, Mich.

VOLT-OHM-MILLIAMETER *model 109*. 4½-in meter, 40 μa movement. Five ac voltage ranges to 3,000 volts at 10,000 ohms per volt, five dc ranges to



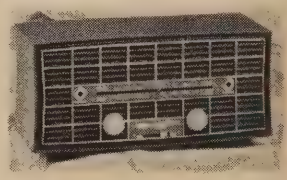
3,000 volts at 20,000 ohms per volt, three each alternating- and direct-current ranges, three resistance ranges to 20 megohms. Kit or factory-wired.—**Electronic Measurements Corp.**, 625 Broadway, New York 12, N. Y.

POCKET VOM KIT *83Y708* 13 ranges, 1,000 ohms per volt. Five dc ranges to 500 volts, four ac ranges to 500 volts, three direct-current ranges to 100 ma, one resistance range to 30,000



ohms. 2½-inch meter.—**Allied Radio Corp.**, 100 N. Western Ave., Chicago 80, Ill.

AIRCRAFT-BAND receiver covers aircraft frequencies 108–130 mc and standard broadcast band. Built-in antenna, speaker, 2 phone jacks. 110 volts ac. Kit



to convert for auto use available.—**Nova-Tech, Inc.**, 1721 Sepulveda Blvd., Manhattan Beach, California.

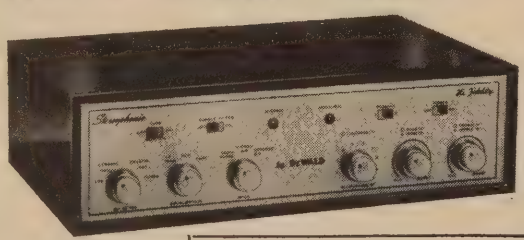
All specifications on these pages are from manufacturers' data.

DeWALD

more for the money

STEREO AND MONAURAL HI-FI COMPONENTS

Double the Quality at Half the Price!



Model 2200 "Classical" 50 Watt Stereo Control Amplifier. 25 W. each channel (100 W. peak). Separate Loudness and Tone Controls. Tape Monitoring and Direct Tape Recording jacks.

$139.95 AUDIOPHILE NET (CASE INCLUDED)

"You Never Heard It So Good!"

Model N-803-B FM-AM TUNER $77.95 (CASE INCLUDED)

Model N-1000-B Stereo & Monophonic AM-FM Tuner $99.95 (CASE INCLUDED)

Model N-1200-B 30 watt Stereo Control Amplifier $99.95 (CASE INCLUDED)

OVER 35 YEARS OF DEPENDABILITY!

EXPORT DEPT.: 25 Warren St. New York, N.Y. Cable Address: SIMONTRICE

In Canada: L. J. BARDWELL CO. Box 142—Station D Toronto 9, Ontario

DeWALD

A DIVISION OF UNITED SCIENTIFIC LABORATORIES, Inc.
35-07 37th Ave., Long Island City 1, N. Y.

Free! ILLUSTRATED BROCHURE ON REQUEST

PHOTOS

RADIO-ELECTRONICS can use good photographs of service benches, service shops, high-fidelity audio layouts, and any other interesting and original radio-electronic devices.

We will pay $7.50 each for good professional photos or equivalent, suitable for reproduction.

Full information on subject photographed will increase their acceptability.

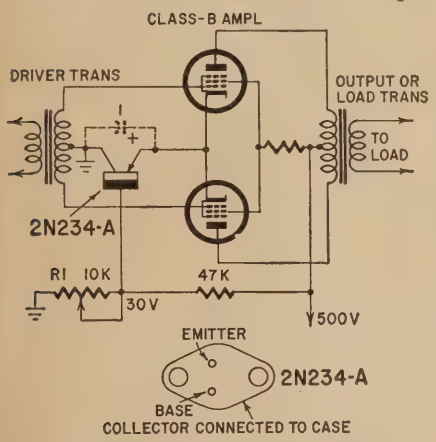
The Editor,

Radio-Electronics
154 West 14th St., New York 11, N. Y.

NOTEWORTHY CIRCUITS

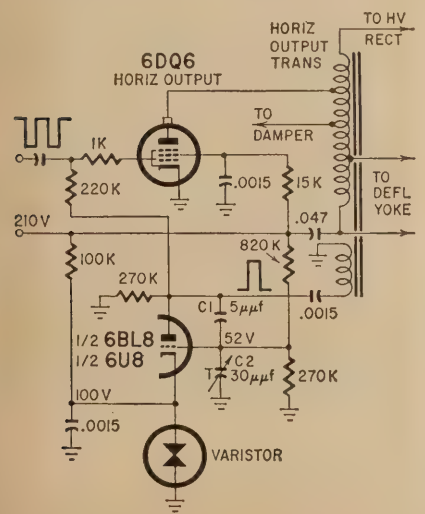
CLASS-B BIAS CIRCUIT

The transistor bias circuit is recommended for use in portable Class-B amplifiers and modulators where a negative grid bias supply is not available. The transistor can be used to supply well-regulated bias to the class-B amplifier's cathode. The cathode voltage will be equal to the bias voltage, which should be adjusted with R1 for the particular tube being used. The transistor should be bypassed by a 1-μf capacitor (dashed lines) for hi-fi applications.—*Bendix Semiconductors*



WIDTH STABILIZATION

A clever circuit for stabilizing picture size against supply-voltage variations and high-voltage current variations appeared in *Funk Technik* (Berlin, 12-58). The diagram shows that only an additional triode is needed—here the triode section of a 6BL8 or 6U8.



A varistor is connected between the triode's cathode and ground to stabilize cathode potential at 100 volts. A resistance divider between B-plus and ground sets the grid voltage at 52, so the grid is normally 48 volts negative with respect to the cathode and the tube is cut off. There is no plate current, and the horizontal output tube's grid simply returns to ground through two resistances in series.

A separate winding on the horizontal output transformer provides a positive pulse proportional to the output of the power stage. It is applied to the triode's plate and simultaneously to its grid through a voltage divider made up of capacitors C1 and C2.

During retrace, the triode conducts and passes a current which is mainly a function of its grid voltage, that is a function of the output power and also of the dc supply voltage since its fixes the grid's dc potential. The voltage drop developed across resistor R is used as a bias for the horizontal output tube.

Experimental results show that picture width does not vary appreciably for tube currents between 50 and 150 μa, and for B-plus voltages between 170 and 250.—*M. De France* END

Transistor Radio Servicing CAN be Highly Profitable

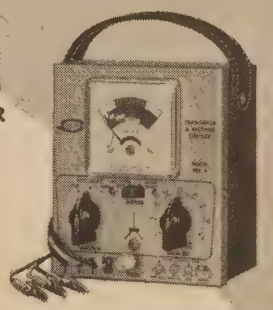
The ONLY Complete Transistor Radio Service Lab

Everything you need for less than $50

Check Transistors, Diodes, Rectifiers . . .

SENCORE TRC4 TRANSISTOR CHECKER

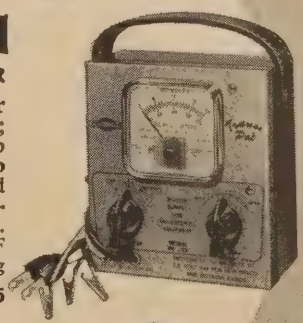
Accurately checks all transistors in hearing aids, radios and power transistors in auto radios. Tests for opens, shorts, leakage, current gain. Measures forward-reverse current ratio on all crystal diodes. Measures forward and reverse currents on selenium rectifiers. With set-up chart for accurate checking of each transistor. Size, 5x4½x2½". With batteries. DEALER NET..... 17.95



Replace Batteries During Repair . . .

SENCORE PS103 BATTERY ELIMINATOR

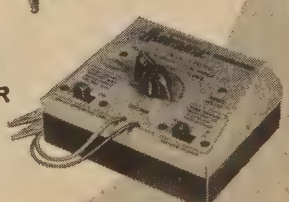
All-new "Transi-Pak," twin to TRC4 Checker above. Provides variable DC voltage to 24 volts; 1.5-volt biasing tap (a "must" for servicing Philco and Sylvania radios). Metered current output, to 100 ma. Handles 200-ma peaks. Two 200-mfd electrolytics provide proper filtering and low output impedance. No hum or feedback problems. Ideal for alignment using station signal; adjust IF slugs for max. current, also ideal for charging nickel-cadmium batteries. Size, 5x4½x2½". DEALER NET..... 17.95



Find Defective Stage in a Minute . . .

SENCORE HG104 HARMONIC GENERATOR

New signal generator designed primarily for fast signal-tracing of transistor radio circuits. No need to unsolder all transistors. Provides RF, IF and audio signals *simultaneously*, drastically cutting service time. Traces from speaker to antenna. Clear 1000 cycle note signal is heard in speaker from all good stages. Signal weakens or stops at defective stage. Equally as effective for testing TV, hi-fi and other audio circuits also. Size, 3½x4½x1¾". With batteries. DEALER NET..... 9.95



Turn page for other SENCORE® Time Savers

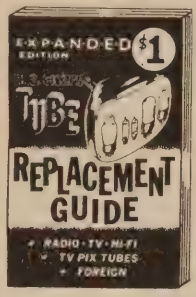
See your Parts Distributor NOW!

SENCORE

ADDISON 2, ILLINOIS

TUBE REPLACEMENT GUIDE

EVERYONE who uses vacuum tubes NEEDS this new 1960 Expanded Edition TUBE GUIDE!



Contains over 2700 substitutes for over 1500 tubes, including radio & TV receiving tubes, tubes used in Hi-Fi & Stereo, foreign tubes and TV picture tubes.

All tubes suggested for substitution have characteristics similar to those they are to replace, FIT INTO SAME SOCKET & NEED NO WIRING CHANGE.

Two chapters cover complete listing of TV Pix tube replacements including newest 110° tubes.

Substitutes given for over 225 foreign tubes. Last chapter lists transistor substitutes. The only complete GUIDE featuring all receiving tube SUBSTITUTIONS WITHOUT SOCKET CHANGES OR REWIRING.

This valuable book will save you TIME & MONEY and permit operation even though original tubes are unavailable.

Guaranteed Money Back in 5 days if Not Satisfied.
Order from your Parts jobber or RUSH COUPON NOW!

$1 Post-paid

H. G. CISIN, Consulting Engineer—Dept. E 53
Amagansett, N.Y.

Enclosed find $1. Rush TUBE REPLACEMENT GUIDE.

Name .....

Address .....

City ..... Zone ..... State .....

MAIL ORDER HI-FI

You can now purchase all your HI-FI from one reliable source and be assured of perfect delivery. Carston makes delivery from NY stock on most Hi-Fi, Recorders and tape within 24 hours. SEND US A LIST OF YOUR HI-FI REQUIREMENTS FOR OUR WHOLESALE QUOTATION and our FREE wholesale catalogue.

CARSTON STUDIOS 125-RD E. 88 St. New York 28, N. Y.

PURCHASING A HI-FI SYSTEM?

Send Us Your List Of Components For A Package Quotation

WE WON'T BE UNDERSOLD!

All merchandise is brand new, factory fresh & guaranteed.

Free Hi Fi Catalog Available on Request.

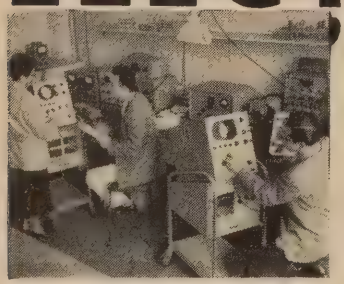
AIREX RADIO CORPORATION
64-RE Cortlandt St., N.Y. 7, CO 7-2137

PARTIAL LIST OF BRANDS IN STOCK

Altec Lansing
Electrovoice
Jensen • Stephens
Hartley
University
Acoustic Research
Janszen
Wharfedale
Karlson Cabinets
Viking
Concertone
Bell • G.E.
Weathers
Harman–Kardon
Eico • Pilot
Sherwood
Acrosound
Fisher • Dual Changer
Bogen • Leak
Dynakit
H. H. Scott
Ferrograph
Tanberg
Pentron
Ampex • De Wald
Revere
Challenger
Wollensak
Garrard
Miracord
Glaser-Steers
Rek-O-Kut
Components
Norelco
Fairchild
Pickering • Gray
Audio Tape
Conrac
Wellcor Cabinets

BONAFIDE
now offers the biggest discounts on all famous HI-FI & Stereo components or kits of your choice.
BONAFIDE
not only can give you the best deal & expert advice but also guarantees everything sold. Write for our special price Quotations on package deals. No sale too small.
BONAFIDE ELECTRONICS
Dept. RE12, 89½ Cortland St., N.Y. 7, N.Y.

ELECTRONICS



AT HEALD'S YOU LEARN BY ACTUAL PRACTICE IN MODERN LABORATORIES . . . AND GET TOP PAY JOBS.

HEALD'S
ENGINEERING COLLEGE
Established 1863
Van Ness at Post, RE
San Francisco, Calif.

ENGINEERING-TECHNICIANS

Bachelor of Science Degree, 30 Months
Save Two Years' Time

- ☐ Radio-TV Technician including Color TV (12 Months)
- ☐ Electronics Technician (12 Months)
- ☐ Industrial Electronics Technician (12 Months)
- ☐ Electronics Engineering (B.S. Degree)
- ☐ Electrical Engineering (B.S. Degree)
- ☐ Mechanical Engineering (B.S. Degree)
- ☐ Civil Engineering (B.S. Degree)
- ☐ Architecture (B.S. Degree)

Heald College ranks FIRST West of the Mississippi in "Who's Who in America"

Approved for Veterans
DAY AND EVENING CLASSES
Write for Catalog and Registration Application.
New Term Starting Soon.

Your Name .....

Address .....

City .....

State .....

Technotes

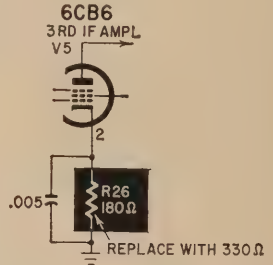
RCA 7-BT-9J

If you don't get any audio output from this transistor radio, make sure that the crystal diode detector (CR1) is not shorted to the can of the third if transformer (T4). Place a piece of tape on the can to cover the spot that the diode might contact. — *C. S. Lawrence*

SPARTON 21322

The set lost sync on strong locals but was OK on weaker channels.

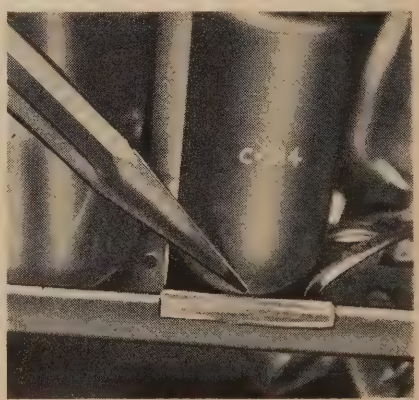
The scope showed sync compression originating in the last if amplifier. The



cure called for replacing cathode resistor R26, 180 ohms, with a larger value, 330 ohms. The added bias permits a more normal input to the video detector from the third if amplifier.— *Phillip Monroe*

G-E PORTABLE MM

The set had a slightly undersized raster and sound and picture were missing. Resistance checks indicated a short on the 135 volts developed at the cathode of the audio output tube. This line feeds the if and other tubes. Since the short remained even with these



tubes removed, the chassis was wiggled out of the case—and the short vanished. Flexing the chassis would make the short come and go.

Close inspection revealed that the can terminal of capacitor C314 was grounding to the chassis apron. After moving the capacitor to clear the short, a piece

of plastic insulating tubing was cemented to the apron to prevent a recurrence of the fault.—*Allan F. Kinckiner*

EMERSON 163-D

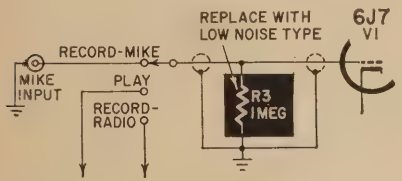
Complaint: No high voltage.

Reason: Horizontal output transformer has high resistance. Check B-boost voltage. If it is 200 volts instead of the normal 430, and everything else checks normal, measure the resistance between horizontal output transformer terminals 5, 4 and 6. If you find 150 ohms or higher instead of 36, replace the transformer.—*Harry C. Keller*

BRUSH SOUNDMIRROR MODEL 414

Complaint: Noisy recording and reproduction.

Cure: Replace 1-megohm resistor R3 (grid leak resistor of first amplifier,



V1) with a deposited film or other relatively noiseless type of resistor. Do not overheat while soldering the replacement into position or it may become noisy also.—*Lawrence Shaw*

HORIZONTAL FOLDOVER

One headache problem in older TV receivers is horizontal foldover. This trouble is usually caused by a longer retrace time in the flyback transformer than in the horizontal oscillator, and frequently occurs in sets that use the Synchroguide circuit.

Since the trouble is associated with a characteristic of circuit components, no easy cure is available. But the simplest way to overcome the foldover is to blank it out. Only a narrow band of the picture is lost.

The easiest way to blank out the foldover is by using the picture tube's first anode. Simply connect 100,000 ohms and 400,000 ohms resistance in series between the damper tube's plate and cathode. The lead from the picture tube's first anode should be connected to the junction of these resistors. If this does not completely cure a particular case of foldover, substitute 330,000 ohms for the 400,000 ohms recommended. If you get too much blanking, increase the 400,000 ohms to about 470,000 ohms.—*Blackburn Hall*

G-E 646 PORTABLE RADIO

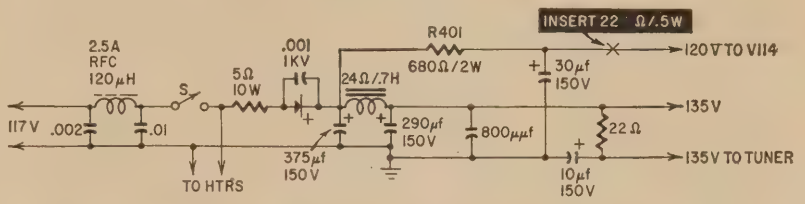
The set would not track the low-frequency stations properly. No low frequency adjustment of the oscillator coil is provided nor is a padder capacitor available for low-frequency adjustment.

A turn of No. 18 solid wire was fashioned into a loop which could be moved up and down on the oscillator coil. One end of the loop was grounded to B-minus. To get satisfactory low-frequency tracking, the loop adjustment was manipulated. Then the high-frequency trimmers were readjusted as in any other alignment when the coil inductance is shifted.—*A. R. Clawson*

G-E 14P1209

Complaint: Barkhausen oscillation which appears only on channel 5.

Add a 22-ohm ½-watt carbon resistor in series with the audio output tube's (V114) B supply and resistor R401 (see diagram).—*Larry Steckler* END



Servicemen! SAVE TIME...SUBSTITUTE THE SENCORE WAY
The Fastest, Surest Method Known!
Substitute for Capacitors, Resistors
SENCORE H-36—THE "HANDY 36"
36 most-often-needed resistors and capacitors, for fast, easy, direct substitution in all circuits. • Eliminates searching for replacement components for test purposes. • Avoids unnecessary unsoldering and soldering—no more solder mess. • Pays for itself the first month in time saved. • Flick of a switch instantly selects any one of . . .
24 RESISTORS from 10 ohms to 5.6 megohms
10 CAPACITORS from 100 mmfd to .5 mfd
2 ELECTROLYTICS, 10 mfd and 40 mfd
DEALER NET..... 12.75
Substitute for Electrolytic Capacitors
SENCORE ES102 ELECTRO-SUB
Usable from 2 to 450 volts, D.C.
Contains 10 electrolytics from 4 to 350 mfd. Select the correct value with the flick of a switch. Features automatic discharge, surge protector circuit. Prevents accidental "healing" of capacitor being bridged. Completely safe—no arc or spark when connecting or disconnecting. DEALER NET..... 15.95
Substitute for Fuse Resistors During Repair
SENCORE FS3 "FUSE-SAFE" CIRCUIT TESTER
Instantly tells you whether or not it is safe to replace fuse resistors, fuses, or circuit breakers. Separate red and green scale for each commercially available fuse resistor used in radio and TV. Eliminates guesswork and wasted time. Also handy for wattage checks up to 1100 watts. DEALER NET..... 8.95
Substitute for Bias Batteries During Repair
SENCORE BE3 "ALIGN-O-PAK"
Completely isolated DC supply, with less than 0.1% ripple. Eliminates messy batteries in TV service work. Handy for alignment, AGC trouble-shooting, or checking gated sync circuits. Just dial the voltage you need, 0-18 volts, positive or negative. Covers all voltages recommended by TV set manufacturers. Size, 3½x4½x1¾". For 110-120 volts, 60 cycle AC.
DEALER NET..... 7.85
UNIVERSAL TV JUMPER CORD
Fits any set from back to chassis. Box has male and female plugs for additional power source, soldering, etc. DEALER NET 1.95
Turn page for other
SENCORE
Time Savers
See your Parts Distributor Now!
SENCORE
ADDISON 2, ILLINOIS

IF MORE KNOW-HOW IN THESE VITAL ELECTRONIC AREAS MEANS GREATER INCOME

...there's a **RIDER BOOK** *for you*

JUST PUBLISHED VOLUME 6 BASIC ELECTRONICS *by Van Valkenburgh, Nooger & Neville Inc.* We are pleased to announce the publication of Volume 6 BASIC ELECTRONICS by Van Valkenburgh, Nooger & Neville. Volume 6 is a companion volume to the present five volume course on BASIC ELECTRONICS by the above authors. It is intended to enable you to expand into the areas of semiconductors, transistors and frequency modulation after the content of the first five volumes has been completed. Volume 6 utilizes the same famous "picture-book" technique used in the present highly successful five volume course.

The original five volume course in BASIC ELECTRONICS—a standard for thousands beginning their career in electronics—is available as heretofore as five individual volumes in paper covers and as all five volumes in one cloth binding. Volume 6 #170-6 soft cover, **$2.90;** #170-6H, cloth **$3.60.**

HOW TO USE GRID-DIP OSCILLATORS *by Rufus P. Turner K6AI.* The first book ever devoted entirely to grid-dip oscillators tells you how to construct and use this very versatile instrument with best possible results. Its many applications are useful to service technicians — radio amateurs — laboratory technicians — students studying electronics and experimenters. It is applicable to all kinds of radio receivers and transmitters, also to television receivers. The grid-dip oscillator is a troubleshooting device — an adjusting device — a frequency measuring device — applicable to circuits and components in circuits — to antennas; also a signal source of variable frequency. Where calculations are involved in the application, sample problems are completely worked out for the reader. #245, **$2.50.**

BASIC AREAS OF ELECTRONICS

BASIC ELECTRICITY (Picture Book Course) *by Van Valkenburgh, Nooger & Neville* #169, 5 vols., soft covers, **$10.00;** #169H, cloth, **$11.50.**

BASIC ELECTRONICS (Picture Book Course) *by Van Valkenburgh, Nooger & Neville* #170, 5 vols., soft covers, **$10.00;** #170H, cloth, **$11.50.**

BASIC TELEVISION (Picture Book Course) *by Alex. Schure,* Ph.D. #198, 5 vols., soft covers, **$10.00;** #198H, cloth, **$11.50.**

HOW TO READ SCHEMATIC DIAGRAMS *by D. Mark,* #208, **$3.50.**

BASIC VACUUM TUBES & THEIR USES *by Rider & Jacobowitz,* #171, **$3.00;** #171H, cloth, **$4.50.**

INTRODUCTION TO PRINTED CIRCUITS *by R. L. Swiggett,* #185, **$2.70.**

R-L-C COMPONENTS HANDBOOK *by David Mark,* #227, **$3.50.**

SPACE AGE & NUCLEAR FUNDAMENTALS

BASICS OF MISSILE GUIDANCE & SPACE TECHNIQUES (Picture Book Course) *by M. Hobbs,* #229, 2 vols., soft covers, **$7.80;** #229H, cloth, **$9.00.**

FUNDAMENTALS OF RADIO TELEMETRY *by M. Tepper,* #225, **$2.95.**

EFFECTS OF NUCLEAR RADIATION ON MEN & MATERIALS *by T. C. Helvey,* #243, **$1.80.**

FUNDAMENTALS OF NUCLEAR ENERGY & POWER REACTORS *by Henry Jacobowitz,* #218, **$2.95.**

COMPUTERS

BASICS OF DIGITAL COMPUTERS (Picture Book Course) *by John S. Murphy,* #196, 3 vols., soft cover, **$7.50;** #196H, cloth, **$8.50.**

DESIGN OF TRANSISTORIZED CIRCUITS FOR DIGITAL COMPUTERS *by Abraham I. Pressman, M.S.,* #215, cloth bound, **$9.95.**

TRANSISTORS

FUNDAMENTALS OF TRANSISTORS (2nd ed.) *by Leonard M. Krugman, P.E.,* #160, **$3.50.**

PRINCIPLES OF TRANSISTOR CIRCUITS *by S. W. Amos, B.Sc.,* #241, **$3.90.**

TRANSISTOR ENGINEERING REFERENCE HANDBOOK *by H. E. Marrows,* #193, cloth, **$9.95.**

AUDIO AND HIGH FIDELITY

BASIC AUDIO (Picture Book Course) *by Norman H. Crowhurst,* #201, 3 vols., soft covers, **$8.70;** #201H, cloth, **$9.95.**

STEREOPHONIC SOUND *by Norman H. Crowhurst,* #209, **$2.25.**

HIGH FIDELITY SIMPLIFIED (3rd ed.) *by H. D. Weiler,* #142, **$2.50.**

FUNDAMENTALS OF HIGH FIDELITY *by H. Burstein,* #226, **$2.95.**

AMATEUR RADIO

GETTING STARTED IN AMATEUR RADIO *by Julius Berens,* W2PIK, #199, **$2.40.**

BUILDING THE AMATEUR RADIO STATION *by Julius Berens,* W2PIK, #221, **$2.95.**

RADIO OPERATOR'S LICENSE Q & A MANUAL (6th edition) *by Milton Kaufman,* #130, cloth, **$6.60.**

SHORTWAVE PROPAGATION *by S. Leinwoll,* #231, **$3.90.**

SOUND-N-SIGHT CODE COURSE *by Lewis Robins* and *Reed Harris,* Complete Course (0 to 20 words/minute), #REC-020, **$15.95;** Novice Course (0 to 8 words/minute), #REC-08, **$9.50;** Advanced Course (9 to 20 words/minute), #REC-920, **$8.95.**

RADIO-TV-AUDIO SERVICING

REPAIRING TELEVISION RECEIVERS *by Cyrus Glickstein,* #191, **$4.40.**

REPAIRING HI-FI SYSTEMS *by David Fidelman,* #205, **$3.90.**

HOW TO INSTALL & SERVICE AUTO RADIOS (2nd edition) *by Jack Darr,* #159, **$3.25.**

HOW TO USE METERS (2nd edition) *by John F. Rider & Sol D. Prensky,* #144, **$3.90.**

MASTER RECEIVING-PICTURE TUBE SUBSTITUTION GUIDEBOOK *by H. A. Middleton,* (covers original Receiving Tube Substitution Guidebook and all four supplements, expanded, organized in type number sequence and brought up to date), #244, **$7.45.**

*For a short time, the original **RECEIVING TUBE SUBSTITUTION GUIDEBOOK,** its three **SUPPLEMENTS**— and new 4th **SUPPLEMENT** are available.

ENGINEERING TEXTS

CONDUCTANCE CURVE DESIGN MANUAL *by Keats A. Pullen, Jr., Eng.D.,* #210, stiff cover, **$4.25.**

CONDUCTANCE DESIGN OF ACTIVE CIRCUITS *by Keats A. Pullen, Jr., Eng.D.,* #207, cloth, **$9.95.**

Write for 1960 catalog of more than 150 Rider titles.

Prices subject to change without notice. Canadian prices approx. 5% higher.
At your jobber or bookstore, or order direct. RE-1

JOHN F. RIDER PUBLISHER, INC. 116 West 14th Street, New York 11, N. Y.
Canada: Chas. W. Pointon, Ltd., 66 Racine Rd., Rexdale, Ont.
Europe & British Isles: Chapman & Hall Ltd., 37 Essex St., London India: Asia Publishing House, Bombay and other cities

OPPORTUNITY ADLETS

Rates—50c per word (including name, address and initials). Minimum ad 10 words. Cash must accompany all ads except those placed by accredited agencies. Discount, 10% for 12 consecutive issues. Misleading or objectionable ads not accepted. Copy for March issue must reach us before Jan. 15, 1959.

RADIO-ELECTRONICS,
154 West 14 St., New York 11, N. Y.

PRINTING PRESSES, type, supplies. Lists 4¢. TURNBAUGH SERVICE, Mechanicsburg, Pa.

LEARN CIVIL and criminal investigation at home. Earn steady, good pay. INSTITUTE APPLIED SCIENCE, 1920 Sunnyside, Dept. 261, Chicago 40, Ill.

RADIO & TV TUBES at Manufacturers' Prices! 100% Guaranteed! Brand New! No re-brands or pulls! UNITED RADIO, Box 1000, Newark, N.J.

STEREO TAPE RENTALS. For the very best at lowest prices. Write CALIFORNIA TAPED MUSIC ASSN., 763 El Camino Real, Redwood City, Calif.

CASH PAID! Sell your surplus electronic tubes. Want unused, clean radio and TV receiving, transmitting, special-purpose, Magnetrons, Klystrons, broadcast types, etc. Want military & commercial lab/test and communications equipment such as G.R., H.P., AN/UPM prefix. Also want commercial receivers and transmitters. For a fair deal write BARRY, 512 Broadway, New York 12, N. Y. WAlker 5-7000.

HI-FI, Recorders, Tapes. FREE Wholesale Catalogue. CARSTON, 215-T East 88th St., New York 28, N. Y.

DISCOUNTS UP TO 50% on Hi-Fi amplifiers, tuners, speakers, tape recorders, individual quotations only, no catalogs. CLASSIFIED HI-FI EXCHANGE, 2375 East 65th Street, Brooklyn 34, N.Y.

LABORATORY QUALITY equipment and Military Surplus Electronics bought, sold. ENGINEERING ASSOCIATES, 434 Patterson Road, Dayton 9, Ohio.

CAMERA Repairmen greatly needed! You can learn manufacturers' service methods at home, in your spare time! Free, big illustrated book tells how! Write today. NATIONAL CAMERA REPAIR SCHOOL, Dept. RE-9, Englewood, Colorado.

SONGPOEMS and LYRICS WANTED! Mail to: TIN PAN ALLEY, INC. 1650 Broadway, New York 19, N. Y.

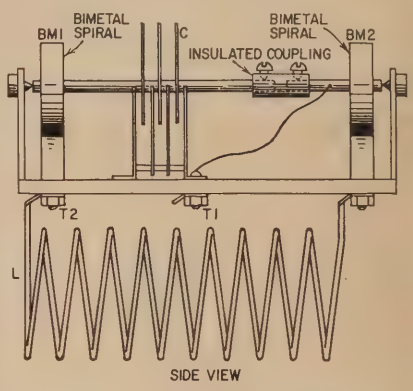
new PATENTS

AUTOMATIC TUNING FOR RF TRANSMITTER

Patent No. 2,860,249

Robert W. Merriam, Seekonk, Mass.

This circuit tunes itself. Bimetal spirals are connected in the rf path. When heated by the current, the spirals tend to expand, causing rotation of the variable capacitor.



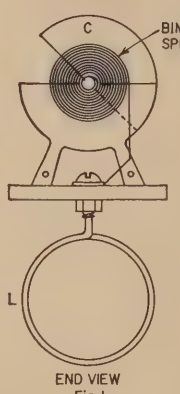


Fig.1

Fig. 1 shows a physical arrangement of the components. Fig. 2 is the corresponding diagram. When the tank is in tune, equal currents flow in L and C, so each bimetal spiral (BM) exerts the same force. Since the spirals are wound to

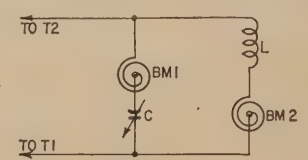


Fig.2

oppose each other, there is no net force. If the tank is off tune, more current will flow through L or C, as the case may be. Then C will tend to rotate until tuning is restored.

DIODE AMPLIFIER

Patent No. 2,879,409

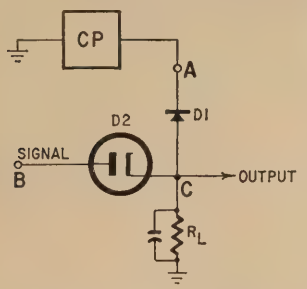
Arthur W. Holt, Silver Spring, Md. (assigned to USA, as represented by Secretary of Commerce)

A diode blocks when its cathode is more positive than its anode. In a semiconductor, blocking cannot occur instantly after a period of conduction. This is because the carriers remaining in the semiconductor must first be swept out. For a short time after reverse bias is applied, a large reverse current flows. This principle is used to obtain pulse amplification in a diode.

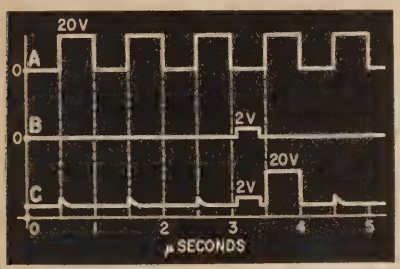
CP is a clock-pulse or square-wave generator

which energizes amplifying diode D1. Positive pulses from a signal source pass through a second diode, D2. Output is taken across R_L. The diagram shows how voltages vary at points A, B and C, with respect to time.

D1 is reverse-biased by the 1-mc pulse from



CP, so it does not conduct. At 3 μsec, a signal pulse (2 volts positive) is impressed. Since CP is zero at the time, it constitutes forward bias for D1. Thus the next CP causes a large reverse current through D1 and R_L. With a



typical gain of 10, the output pulse will be 20 volts.

Diode D1 may be considered to behave like a transistor under the rapidly reversing bias. During the instant of *forward* bias, the diode acts like an emitter-base junction. During *reverse* bias, it acts like a collector-base junction.

IGNITION SYSTEM

Patent No. 2,898,392

Ralph L. Jaeschke, Kenosha, Wis. (Assigned to Eaton Mfg. Co., Cleveland)

This system has a transistor and a transformer to generate sparks. Oscillator V is protected against surges by diode D1. GEN is a four-pole generator (only two are shown) of low

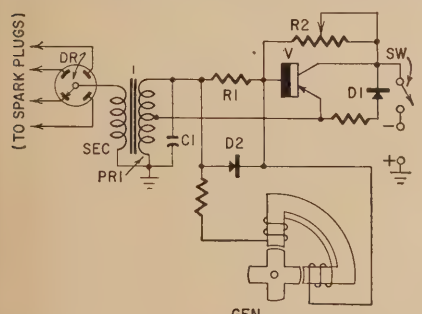


Fig.1

frequency. It is driven at half the engine's speed.

The generator's output is a flattened wave whose negative peaks are further clipped by diode D2 to a suitable value to bias the transistor. At –3 volts on the base, V begins to

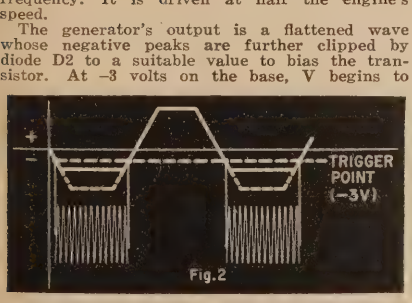


Fig.2

oscillate. During the other half-cycles, V is blocked. The oscillator frequency is about 15 kc, and T-C1 are tuned to it.

Transformer T's secondary induces a voltage of about 10 kv which is delivered to the spark plugs through rotor DR. END

Check TUBES, VIBRATORS THE SENCORE WAY

FAST ACCURATE TROUBLE SHOOTING

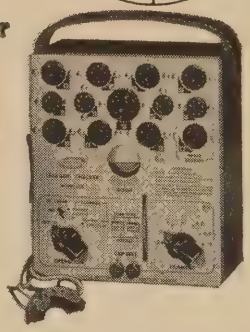
America's Most Popular Tube Tester

more than 25,000 now in use

SENCORE LC3 LEAKAGE CHECKER

Whips those "tough dog" tube troubles . . .

Ask any serviceman who owns one . . . or try one for just one day of servicing in your shop. You'll see for yourself how much time the LC3 can save *you*. Checks for leakage between all elements, whether caused by gas, grid emission or foreign particles. Also checks leakage on all capacitors with voltage applied—including electrolytics. Provides instant filament checks in "Fil-Check" position—no need for a second filament checker. One spare pre-heating socket and new roll chart prevent obsolescence. New charts provided—no charge. Leakage sensitivity, 100 megohms, control grid to all other elements; 50,000 ohms, heater to cathode. Size, 7x6x3½". Wt., 3 lbs. For 110-120 volts, 60 cycle AC. DEALER NET 28.95



NOW . . . checks 172 tube types—more than any other checker of this type.

NEW . . . replaceable Roll Chart prevents obsolescence.

Check Filaments of All Receiving Tubes and Picture Tubes

FC4 FILAMENT CHECKER

For fast, easy checking of all tube filaments, without pulling chassis. Neon light goes out if tube filament is good. Also acts as continuity and voltage tester. Neon lamp glows when 115 v. AC is applied by cheater cord, providing a check on power to TV set. Size, 3⅛x4x1". With leads. DEALER NET..... 2.95

Check 3- and 4-Prong Vibrators . . . Faster, Easier

VB2 "VIBRA-DAPTOR"

Plugs into any tube checker; ideal for use with LC3 above. To check 6-v. vibrators, set for 6AX4 or 6SN7; for 12-v. vibrators, set for 12AX4 or 12SN7. Two No. 51 lamps indicate whether vibrator needs replacing. Instructions on front panel. Steel case. Size, 1½x1½x3" DEALER NET..... 2.75

See your Parts Distributor NOW!

Turn page for other SENCORE Time Savers

SENCORE

ADDISON 2, ILLINOIS

OPPORTUNITY ADLETS (Continued)

ELECTRONIC ASSEMBLY, Kits wired and tested, professional work, 10 to 35 per-cent kit cost, write for details. DAYTON ELECTRONIC ASSOC., 2118 Catalpa Dr., Dayton 6, Ohio.

TRANSISTOR and FM RADIOS. Lowest Prices. Free Catalog. MYERS IMPORTS, 623 Gay, Knoxville, Tenn.

PRINTED-CIRCUIT BOARDS save space and assembly time for your product. Boards designed and manufactured in prototype and production quantities. Send circuit diagram, dimensions, quantity requirements for quotation. Application assistance available. ELECTRONIC AIDS, Box 137, Stamford, Conn.

IN538 SILICON DIODES, 200V 500 Ma. 15 Amp. peak, pencil eraser size, 85¢. 75¢ if over 10. ATOMICRON, 3725 Olive, Kansas City 9, Mo.

APPLIANCE Parts Wholesale, Catalogue 25¢, All Parts Irons-Ranges, Fully illustrated. SECO, 26 S. 20 St., Birmingham, Ala.

STUDY to be Doctor of Psychology, Metaphysics, Divinity or Philosophy. Correspondence courses only. NEOTARIAN FELLOWSHIP, Desk 25, Pickwick Bldg., Kansas City 6, Mo.

ELECTRONIC TECHNICIANS WANTED. Knowledge of power supply construction and wiring with one year experience required. Good opoprtunity with chance for advancement. PRECISE CO., Box 172, Flemington, N.J.

TRADE-IN TV $6 up; also color. Write JUSTIS, Newport, Del.

LEARN WHILE ASLEEP. Hypnotize with your recorder, phonograph or amazing new Electronic Educator endless tape recorder. Catalog, details free. SLEEP-LEARNING ASSOCIATION, Box 24-RD, Olympia, Wash.

RENT STEREO TAPES. Over 800 different, all major labels. Free catalog. Stereo-Parti, 1608-K Centinela Ave., Inglewood 3, Calif.

HI-FI DOCTOR—will solve your hi-fi problems on the spot. Acoustic, Audio, Radio Engineer. Stereo Designing. Professional visits, day evening, New York area. WILLIAM BOHN, Plaza 7-8569, weekdays.

DIAGRAMS FOR REPAIRING RADIOS $1. Television $2. Give make. Model. DIAGRAM SERVICE. Box 627-RE. Hartford 1, Conn.

COMPUTER logic kit $9.95, Math Course $9.95. Other courses computers, physics, transistors. Courses RE, Box 125, Grand Prairie, Texas.

ALL MAKES OF ELECTRICAL INSTRUMENTS AND TESTING equipment repaired. HAZELTON INSTRUMENT CO., 128 Liberty Street, New York, N.Y.

SPECIAL! RUBBER STAMP with pad—Three lines $1.00. IDEAL RUBBER STAMPS, Box 21, Camden, Tenn.

5-INCH TV Test CRT. Complete with adapter $3.95 post paid. CRYSTAL ELECTRONICS, 9507 101st Ave., Ozone Park, N.Y. HI 1-0700.

These men are getting practical training in...

Train in *NEW* Shop-Labs of

COYNE

in Chicago—Electrical and Electronic Center of the World. Prepare for a better job and a successful future in a TOP OPPORTUNITY FIELD. Train on real full size equipment at COYNE where thousands of successful men have trained for 60 years—*largest, oldest, best equipped school of its kind.* Professional and experienced instructors show you how, then do practical jobs yourself on more than a quarter of a million dollars worth of equipment. No previous experience or advanced education needed. Employment Service to Graduates.

Start Now—Pay Later—Liberal Finance and Payment Plans. Pay most of tuition after graduation. Part-time employment help for students. Choose from nine yearly Starting Dates.

Mail Coupon or Write to Address Below for Free Book—"*Guide to Careers,*" Whether you prefer ELECTRICITY, TELEVISION-RADIO OR COMBINED ELECTRONICS, which includes both fields, this book describes all training offered.

Information comes by mail. No obligation and NO SALESMAN WILL CALL.

B. W. Cooke, Jr., Pres. Founded 1899

COYNE ELECTRICAL SCHOOL

Chartered as an Educational Institution Not For Profit

1501 W. Congress Pkwy., Chicago 7, Ill., Dept. 10-5C

MAIL COUPON OR WRITE TO ADDRESS BELOW

COYNE ELECTRICAL SCHOOL
New Coyne Building Dept. 10-5C
1501 W. Congress Pkwy., Chicago 7, Ill.

Send BIG FREE book and details of all the training you offer. I am especially interested in,

☐ Electricity ☐ Television ☐ Both Fields

Name.....

Address.....

City.....State.....

(I understand no Salesman will call)

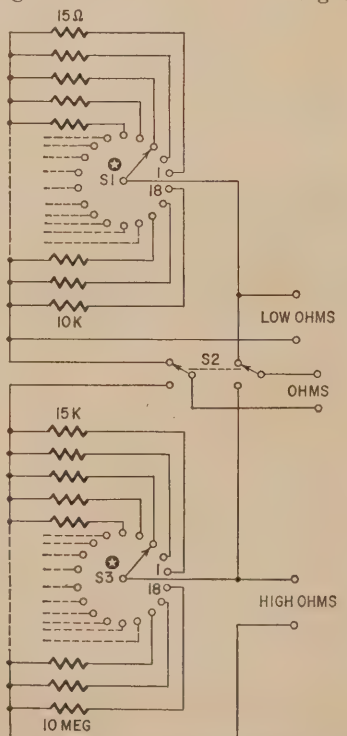
DON'T USE A HEAT LAMP

Instead of using a heat lamp to make an intermittent set act up, I use a soldering pencil (mine has a 37-watt tip) because the lamp heats up too large an area, making it difficult to localize the component which is changing value greatly or opening or shorting because of heat.

I lay the point of the pencil on suspected components, plate and cathode parts first because they carry the greatest current; screen resistors and bypass capacitors next. Grid resistors rarely get hot so I skip them. I leave the hot tip on each component long enough to heat it up, but not enough to ruin it, meanwhile watching the screen. The system works fine! It's important to wait for each component to cool down after testing before trying the next part. Heat lamps are for the birds!—*George Hrischenko*

RESISTANCE-BOX MODIFICATION

Some resistance substitution boxes have separate selector switches for high- and low-resistance ranges but



S1 & S3 ARE SIMPLIFIED DRAWINGS OF 18 POINT RANGE SWITCHES IN EICO 1100

2" to 14" blades, 4 bit sizes. Available with shockproof plastic covered tubing.

Ask For It At Your Dealer

KEDMAN CO., 233 S. 5th W., Salt Lake City, Ut.

TV PICTURE TUBES

At Lowest Prices

10BP4	$ 7.95	17BP4	$ 9.95	21AMP4	$15.75
12LP4	8.50	17CP4	17.00	21ATP4	15.75
14B/CP4	9.95	17GP4	17.60	21AUP4	15.75
16DP4	12.00	17HP4	12.50	21EP4	13.50
16EP4	12.75	17LP4	11.50	21FP4	14.50
16GP4	14.50	17QP4	9.95	21WP4	14.00
16KP4	9.95	17TP4	17.00	21YP4	14.50
16LP4	10.95	19AP4	16.00	21ZP4	13.50
16RP4	9.95	20CP4	13.50	24CP4	23.50
16WP4	12.00	20HP4	14.50	24DP4	24.50
16PT4	9.95	21AP4	22.10	27EP4	39.95
17AVP4	12.50	21ALP4	15.75	27RP4	39.95

1 year warranty

Aluminized Tubes $5.00 more than above prices. Prices include the return of an acceptable similar tube under vacuum. These tubes are manufactured from reprocessed used glass bulbs. All parts and materials including the electron gun are brand new.

ALL PRICES FOB CHICAGO, ILLINOIS. Deposit required, when old tube is not returned, refundable at time of return. 25% deposit required on COD shipments. Old tubes must be returned prepaid. Tubes shipped Rail Express.

WRITE FOR COMPLETE LIST.

—PICTURE TUBE OUTLET—

3032 Milwaukee Ave., Chicago 18, Ill.
Dickens 2-2048

February Issue of

RADIO-ELECTRONICS

will be on Sale

JANUARY 26

Order your copy now!

PARTS
for all
EUROPEAN RADIOS
Foreign Components Company
81-07 Broadway, Elmhurst, N.Y.
Mail Orders Only

BEST IN HI-FI VALUES!

NO DELAY SERVICE

All orders rushed to you in factory-sealed cartons.

Write for free catalog.

audion 25-E Oxford Road Massapequa, New York

only a single set of output terminals. A simple modification lets the operator use low and high ranges simultaneously. This greatly increases their utility in such applications as circuit design. For example, the low range may be used as a variable cathode resistor while the high range is used as a variable plate resistor. Also, the high range can be parallelled across the low range for precise low-range trimming to values not in the original box. Or the low range can be connected in series with the high to permit similar trimming of the high-range values.

In the modified box, individual ranges are fully isolated from each other and connected to two sets of binding posts, which are added to the box. The original spdt switch is replaced with a dpdt unit. This way the original output binding posts can be switched to either of the resistance ranges.

This modification was made to an Eico model 1100K resistance box, but is also applicable to others of similar design. In the Eico box, the additional binding posts are conveniently arranged in a line with the original pair with standard ¾-inch spacing between members of a pair.—*Edward Buder*

DRILLING THIN METAL

When drilling thin metal, brace it so it won't bend by using a soldering iron to stick on a blob of solder at the site of the center punch mark.

The diameter of the solder should be slightly smaller than the drill used and 1/16 inch thick. The solder easily gives way to the drill and holds it there until the hole is started.

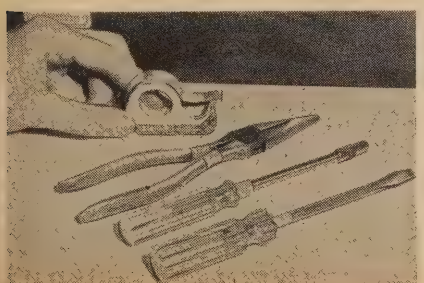
Even more accurate drilling is possible if the top of the solder is flattened by filing.—*Harvey Muller*

TURNING TOUGH SCREWS

In cramped quarters on a chassis where it's difficult to turn a screw with an ordinary screwdriver, I use a blade from an interchangeable screwdriver set chucked in a tap wrench. This tool not only enables me to turn screws in inaccessible places, but the T-handle gives better leverage on other jobs.—*Allen C. Johnston*

COLOR-CODE THOSE TOOLS

If you have trouble keeping the tools you carry in your toolkit from getting mixed up with bench tools in the shop, mark the toolkit ones with bands of bright-colored cellophane tape. If you have ever unloaded your pockets on the bench at the end of a busy day and neglected to put the contents back in your toolkit for use the next day, you'll truly appreciate this kink. The tape is more durable than paint so it won't wear off with frequent handling. If you have more than one kit of tools you want to keep separate, use two colors of tape.—*John C. Abraham*

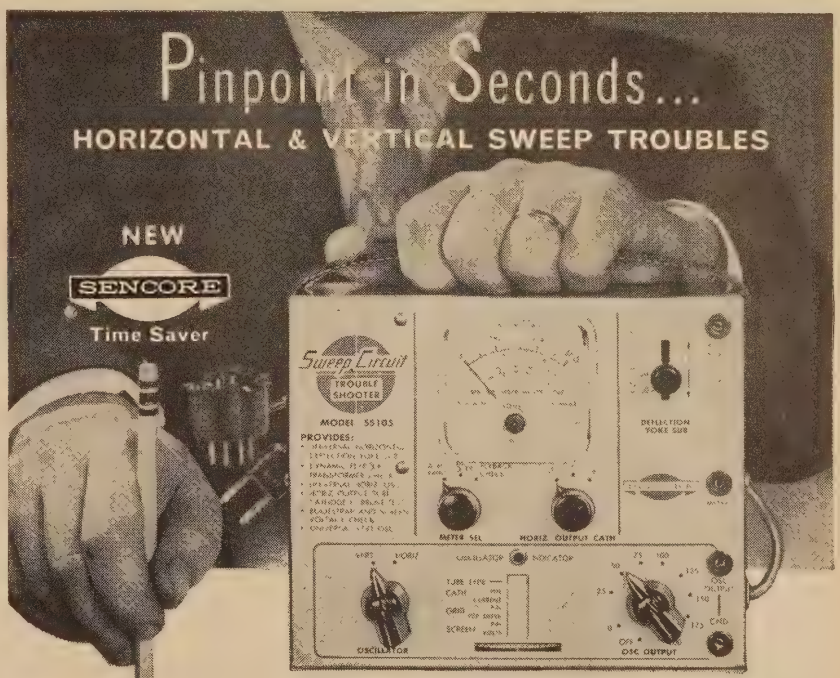


LIQUID METAL SERVICE AID

Ever attempt to replace a back on a TV set only to find the screw holes stripped and too enlarged for the screws?

Whenever I encounter a minor problem of this type, I just reach into my toolkit for the tube of liquid metal that I carry. Now available at most hardware stores, the liquid plastic-powdered metal compound is very handy for many minor service problems. It dries hard like metal and can be used to mend wood, plastic, porcelain, glass and all kinds of metals. It can be drilled, filed, sanded, sawed and painted. Don't try to use it for solder joints designed to pass electricity, though—most of these compounds are pretty good insulators!—*Joe J. Carlson*

END



The missing link in TV service . . .

SENCORE SS105 SWEEP CIRCUIT TROUBLE SHOOTER

IT'S A . . .

UNIVERSAL HORIZONTAL OSCILLATOR. For direct substitution. No wires to disconnect in most cases. Traces trouble right down to the defective component. Variable output from 0-200 volts, peak-to-peak.

HORIZONTAL OUTPUT CATHODE CURRENT CHECKER. A proven method that quickly checks the condition of the horizontal output tube and associated components. Adaptor socket prevents breaking wires. Easily replaceable Roll Chart gives all necessary pin, current and voltage data.

UNIVERSAL DEFLECTION YOKE. A new, simple way to determine yoke failure accurately—without removing yoke from picture tube. Merely disconnect one yoke lead and substitute. If high voltage (also bright vertical line) is restored, TV yoke is defective.

DYNAMIC FLYBACK TRANSFORMER CHECKER. Merely flip switch to "Flyback Check" and meter will indicate condition of flyback transformer, in degrees of horizontal deflection. Extremely sensitive and accurate; even shows up one shorted turn on flyback.

VOLTMETER. For testing bootstrap, screen and other voltages. Direct-reading voltmeter, 0-1000 volts.

UNIVERSAL VERTICAL OSCILLATOR. Checks oscillator, output transformer and yoke. Merely touch lead to component and check picture on screen.

Size, 7x6x3½". Wt. 4 lbs.
For 110-120 volts, 60 cycle AC.

DEALER NET 39.50

See Your Parts Distributor NOW!

SENCORE
ADDISON 2, ILLINOIS

the arm that defies gravity®

Hi Fi Review explains the importance to you of the ESL Gyro/Balance arm:

"A turntable that is not strictly level normally causes the stylus to ride the downhill side of the groove. This is bad enough in monophonic discs, but can be downright disastrous with stereo records where the stylus must always maintain equal contact with both sides of the groove to assure proper channel balance and separation.

"[The **ESL Gyro/Balance** arm's] combined vertical and lateral stabilization... keeps it tracking the groove regardless of turntable tilt. It would even play upside down if the record were glued on.... Aside from these spectacular capabilities, the **ESL** arm is of quality design throughout."

FOR LISTENING AT ITS BEST

Electro-Sonic Laboratories, Inc.

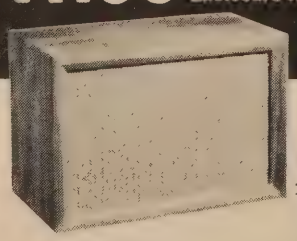
Dept. E • 35-54 Thirty-sixth Street • Long Island City 1, N.Y.

WANT TO GET AHEAD IN SERVICING?

The G/L Technicians' Book Club can help you.

See ad on page 128.

$11.90 Buys You an Acoustic-Designed 12" Bookshelf Enclosure Kit

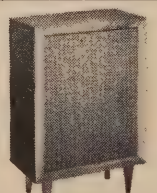


14" H
21" W
11¾" D
20 lbs.

For those of you who need an added enclosure for stereo, or an extension speaker system, or just a space-saver that gives you good sound reproduction—at the lowest price available anywhere — you can't miss with this Model One enclosure kit from Homewood Industries. Here's a company that's been building furniture kits for years and knows how to build value into a kit—and still make it easy to do. Here's what **$11.90** buys—

- A bass-reflex baffle that takes a 12" speaker or an 8" speaker.
- A ¾" plywood enclosure with a four-sided natural veneer finish for horizontal or vertical use.
- A custom-furniture corner design that leaves no end-plys visible.

Price: **11.90** in birch
15.90 in walnut



If the need is for something bigger try the Model Two. Its 4½ feet of baffle area gives you quality reproduction in combination with a 12" speaker. Brass-ferruled legs give it a clean, modern appearance. Meets the highest Homewood standards.

29" H (with legs), 20" W, 12½" D. 25 lbs.
Price: **17.95** in birch

All you need to build is a Hammer-Screwdriver—and 30 minutes! That's how easy it is with a Homewood design.

Satisfaction Guaranteed or your money back in ten days. Send check or money order (no COD's). Freight collect.

HOMEWOOD INDUSTRIES Inc.

26 Court Street, Brooklyn 1, N. Y.

Please send me:
☐ Model One Bookshelf Enclosure
(Birch ☐ Walnut ☐)
☐ Model Two Enclosure ☐ Homewood Catalog
My check ☐ or money-order ☐
for..... is enclosed.

Name.....

Address.....

City.....Zone.....State.....

new LITERATURE

Any or all of these catalogs, bulletins, or periodicals are available to you on request direct to the manufacturers, whose addresses are listed at the end of each item. Use your letterhead—do not use postcards. To facilitate identification, mention the issue and page of RADIO-ELECTRONICS on which the item appears. UNLESS OTHERWISE STATED, ALL ITEMS ARE GRATIS. ALL LITERATURE OFFERS ARE VOID AFTER SIX MONTHS.

TINY TRANSISTOR TRANSFORMERS for industrial use are listed in *catalog 275*. Several size groups in a variety of types and inpedances are detailed. Others can be wound to specifications. Smallest ones measure only 0.237 x 0.340 x 0.280 inch and weigh only .05 ounce.—**Frank Kessler Co. Inc.,** 41-45 47th St., Long Island City 4, N. Y.

CAPACITORS FOR INDUSTRIAL and commercial use are listed with dimensions and brief specifications in a 6-page catalog of the company's complete capacitor line.—**Astron Sales Corp.,** 255 Grant Ave., East Newark, N. J.

AC VOLTMETER battery - operated *model 403A* is described with complete specifications in a 2-page catalog sheet. —**Hewlett-Packard Co.,** 275 Page Mill Road, Palo Alto, Calif.

UNIVERSAL TUBE TESTERS are discussed by Bud Tomer in *Tech Tips* bulletin *PA-500, The Final Authority,* which points out why the equipment is the best for testing tubes.—**CBS Electronics,** Danvers, Mass.

TUBE AND TRANSISTOR TESTERS and other servicing instruments are pictured and described with prices in a small 6-fold brochure.—**Seco Mfg. Co.,** 5015 Penn. Ave. S., Minneapolis, Minn.

MICROMINIATURE CAPACITOR electrical and physical characteristics with charts and drawings covering values to .01 μf are shown on 2-page catalog sheet.—**Vitramon, Inc.,** Box 544, Bridgeport, Conn.

TANTALUM AND ALUMINUM capacitors are described with specifications and dimensions in each of two 4-page bulletins. *GEA-7008* concerns high-capacitance small-size tantalum units for low-voltage transistor applications; *GEA-6819A,* computer-grade aluminum units of 300 to 150,000 μf. — **General Electric Co.,** Schenectady 5, N. Y.

AN/MS CONNECTORS for Government and commercial use are listed with diagrams of pin connections and wire sizes. Plugs accommodating from 1 to

BECOME A RADIO TECHNICIAN For Only $22.95

BUILD 16 RADIO CIRCUITS AT HOME

All Guaranteed to Work!

Progressive Radio "Edu-Kit"®

PRACTICAL HOME RADIO COURSE only $22.95

NOW INCLUDES

★ 12 RECEIVERS
★ TRANSMITTER
★ SIGNAL TRACER
★ SIGNAL INJECTOR
★ CODE OSCILLATOR

★ No Knowledge of Radio Necessary
★ No Additional Parts or Tools Needed

Unconditional Money-Back Guarantee

It is understood and agreed that should the Progressive Radio "Edu-Kit" be returned to Progressive "Edu-Kits" Inc. for any reason whatever, the purchase price will be refunded in full, without quibble or question, and without delay.

The high recognition which Progressive "Edu-Kits" Inc. has earned through its many years of service to the public is due to its unconditional insistence upon the maintenance of perfect engineering, the highest instructional standards, and 100% adherence to its Unconditional Money-Back Guarantee. As a result, we do not have a single dissatisfied customer throughout the entire world.

FREE EXTRAS

- **SET OF TOOLS**
- **SOLDERING IRON**
- **ELECTRONICS TESTER**
- PLIERS-CUTTERS
- ALIGNMENT TOOL
- WRENCH SET
- VALUABLE DISCOUNT CARD
- CERTIFICATE OF MERIT
- TESTER INSTRUCTION MANUAL
- HIGH FIDELITY GUIDE • QUIZZES
- TELEVISION BOOK • RADIO TROUBLE-SHOOTING BOOK
- MEMBERSHIP IN RADIO-TV CLUB: CONSULTATION SERVICE • FCC AMATEUR LICENSE TRAINING
- PRINTED CIRCUITRY

YOU DON'T HAVE TO SPEND HUNDREDS OF DOLLARS FOR A RADIO COURSE

The "Edu-Kit" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. Our Kit is designed to train Radio & Electronics Technicians, making use of the most modern methods of home training. You will learn radio theory, construction practice and servicing. THIS IS A COMPLETE RADIO COURSE IN EVERY DETAIL.

You will learn how to build radios, using regular schematics; how to wire and solder in a professional manner: how to service radios. You will work with the standard type of punched metal chassis as well as the latest development of Printed Circuit chassis.

You will learn the basic principles of radio. You will construct, study and work with RF and AF amplifiers and oscillators, detectors, rectifiers, test equipment. You will learn and practice code, using the Progressive Code Oscillator. You will learn and practice trouble-shooting, using the Progressive Signal Tracer, Progressive Signal Injector, Progressive Dynamic Radio & Electronics Tester and the accompanying instructional material.

You will receive training for the Novice, Technician and General Classes of F.C.C. Radio Amateur Licenses. You will build 16 Receiver, Transmitter, Code Oscillator, Signal Tracer and Signal Injector circuits, and learn how to operate them. You will receive an excellent background for television, Hi-Fi and Electronics.

Absolutely no previous knowledge of radio or science is required. The "Edu-Kit" is the product of many years of teaching and engineering experience. The "Edu-Kit" will provide you with a basic education in Electronics and Radio, worth many times the complete price of $22.95. The Signal Tracer alone is worth more than the price of the entire Kit.

THE KIT FOR EVERYONE

You do not need the slightest background in radio or science. Whether you are interested in Radio & Electronics because you want an interesting hobby, a well paying business or a job with a future, you will find the "Edu-Kit" a worth-while investment.

Many thousands of individuals of all ages and backgrounds have successfully used the "Edu-Kit" in more than 79 countries of the world. The "Edu-Kit" has been carefully designed, step by step, so that you cannot make a mistake. The "Edu-Kit" allows you to teach yourself at your own rate. No instructor is necessary.

PROGRESSIVE TEACHING METHOD

The Progressive Radio "Edu-Kit" is the foremost educational radio kit in the world, and is universally accepted as the standard in the field of electronics training. The "Edu-Kit" uses the modern educational principle of "Learn by Doing." Therefore you construct, learn schematics, study theory, practice trouble-shooting—all in a closely integrated program designed to provide an easily-learned, thorough and interesting background in radio.

You begin by examining the various radio parts of the "Edu-Kit." You then learn the function, theory and wiring of these parts. Then you build a simple radio. With this first set you will enjoy listening to regular broadcast stations, learn theory, practice testing and trouble-shooting. Then you build a more advanced radio, learn more advanced theory and techniques. Gradually, in a progressive manner, and at your own rate, you will find yourself constructing more advanced multi-tube radio circuits, and doing work like a professional Radio Technician.

Included in the "Edu-Kit" course are sixteen Receiver, Transmitter, Code Oscillator, Signal Tracer, and Signal Injector circuits. These are not unprofessional "breadboard" experiments, but genuine radio circuits, constructed by means of professional wiring and soldering on metal chassis, plus the new method of radio construction known as "Printed Circuitry." These circuits operate on your regular AC or DC house current.

THE "EDU-KIT" IS COMPLETE

You will receive all parts and instructions necessary to build 16 different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, tie strips, coils, hardware, tubing, punched metal chassis, Instruction Manuals, hook-up wire, solder, etc.

In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio and Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Code Oscillator, in addition to F.C.C.-type Questions and Answers for Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, a High Fidelity Guide and a Quiz Book. You receive Membership in Radio-TV Club, Free Consultation Service, Certificate of Merit and Discount Privileges. You receive all parts, tools, instructions, etc. Everything is yours to keep.

SERVICING LESSONS

You will learn trouble-shooting and servicing in a progressive manner. You will practice repairs on the sets that you construct. You will learn symptoms and causes of trouble in home, portable and car radios. You will learn how to use the professional Signal Tracer, the unique Signal Injector and the dynamic Radio & Electronics Tester. While you are learning in this practical way, you will be able to do many a repair job for your friends and neighbors, and charge fees which will far exceed the price of the "Edu-Kit." Our Consultation Service will help you with any technical problems you may have.

J. Stataitis, of 25 Poplar Pl., Waterbury, Conn., writes: "I have repaired several sets for my friends, and made money. The "Edu-Kit" paid for itself. I was ready to spend $240 for a Course, but I found your ad and sent for your Kit."

FROM OUR MAIL BAG

Ben Valerio, P. O. Box 21, Magna, Utah: "The Edu-Kits are wonderful. Here I am sending you the questions and also the answers for them. I have been in Radio for the last seven years, but like to work with Radio Kits, and like to build Radio Testing Equipment. I enjoyed every minute I worked with the different kits; the Signal Tracer works fine. Also like to let you know that I feel proud of becoming a member of your Radio-TV Club."

Robert L. Shuff, 1534 Monroe Ave., Huntington, W. Va.: "Thought I would drop you a few lines to say that I received my Edu-Kit, and was really amazed that such a bargain can be had at such a low price. I have already started repairing radios and phonographs. My friends were really surprised to see me get into the swing of it so quickly. The Troubleshooting Tester that comes with the Kit is really swell, and finds the trouble, if there is any to be found."

PRINTED CIRCUITRY

At no increase in price, the "Edu-Kit" now includes Printed Circuitry. You build a Printed Circuit Signal Injector, a unique servicing instrument that can detect many Radio and TV troubles. This revolutionary new technique of radio construction is now becoming popular in commercial radio and TV sets.

A Printed Circuit is a special insulated chassis on which has been deposited a conducting material which takes the place of wiring. The various parts are merely plugged in and soldered to terminals.

Printed Circuitry is the basis of modern Automation Electronics. A knowledge of this subject is a necessity today for anyone interested in Electronics.

ORDER DIRECT FROM AD—RECEIVE FREE BONUS RESISTOR AND CONDENSER KITS WORTH $7

☐ Send "Edu-Kit" postpaid. I enclose full payment of $22.95.
☐ Send "Edu-Kit" C.O.D. I will pay $22.95 plus postage.
☐ Rush me FREE descriptive literature concerning "Edu-Kit."

Name.....

Address.....

.....

PROGRESSIVE "EDU-KITS" INC.

Progressive Building, Dept. 160G, 1184-86 Broadway, Hewlett, N. Y.

—"TAB" Tubes Tested, Inspected, Boxed—

Six Months Guarantee!! No Rejects!

NEW & Used Gov't & Mfgrs. Surplus!

Orders $10 or more, Receiving types only ppd, 48 states

0A2	.80	6BJ6	.69	12AT6	.59	1851	1.00
0B2	.65	6BK7	.99	12AT7	.84	117Z6	1.10
0C3	.69	6BL7	1.25	12AU6	.69	4-65A	16.00
0D3	.55	6BN6	.98	12AU7	.69	2D21	2/$1
0Z4	.59	6BQ6	1.19	12AX7	.79	3D23	3.85
1A7	.89	6BZ7	1.25	12BA6	.65	717A	2/$1
1B3	.78	6C4	.43	12BA7	.99	4-125	29.00
1R5	.78	6C5	.69	12BD6	.59	4-250	35.00
1S4	.78	6CB6	.80	12BE6	.59	4E27	7.00
1T4	.78	6CD6	1.49	12BF6	.59	4PR60	29.50

Send $1¢ for Catalog!

1U4	3/$1	6H6	3/$1	12BH7	.99	4X150	5.00
1U5	.73	6J5	.52	12BY7	.98	4X250	35.00
1X2A	.98	6J6	.48	12BZ7	.99	4X500	38.00
3Q4	.68	6K6	.59	12CU6	1.45	5BP1	4.98
3Q5	.86	6K7	.74	12SA7	.94	5BP4	4.98
3S4	.68	6L6	1.19	12SQ7	.89	35T	4.00
3V4	.83	6S4	.59	12SH7	.89	100T	7.00
5R4	.98	6S8	.99	12SJ7	.75	316A	5/$1
5U4	.99	6SA7	.69	12SK7	.94	388A	3/$1
5V4	.89	6SB7	1.19	12SQ7	.84	416B	16.00

Wanted Surplus Electronics from schools & U

5Y3	.59	6SC7	.89	19BG6	2.15	450T	42.00
6AB4	.59	6SG7	.79	19T8	.79	807	1.00
6AC7	.70	6SH7	.69	25BQ6	1.39	809	3.00
6AG7	.89	6SJ7	.69	25L6	.69	811A	4.40
6AH6	.99	6SK7	.72	25W4	.77	812	3.00
6AK5	.69	6SL7	.89	25Z5	.63	813	9.00
6AL5	2/$1	6SN7	2/$1	25Z6	.75	814	3.45
6AQ5	.63	6SQ7	.74	EL34	3.49	815	2.75
6AS7	3.00	6SR7	.79	KT87	2.49	826	.59
6AT6	.49	6T8	.98	35L6	.69	829B	8.00

Wanted 304 tubes! Top $ $ Paid

6AU4	1.10	6U8	.98	35W4	.49	832A	7.00
6AU5	1.19	6V6GT	.70	35Y4	.69	866A	2.75
6AU6	.69	6W4	.79	35Z5	.63	1B22	5/$1
6AX4	.79	6W6	.89	50A5	.69	6146	4.00
6BA6	.59	6X4	2/$1	50B5	.69	5879	.98
6BA7	1.00	6X5	.49	50C5	.69	5881	2.70
6BD6	.69	6Y6	.97	50L6	.69	8550	5.90
6BE6	.59	7N7	.89	KT66	3.29	5654	1.00
6BG6	1.50	12AL5	.59	75	.89	5894	12.00
6BH6	.72	12AQ5	.75	80	.59	7193	10/$1

TUBES WANTED! WE BUY! SELL & TRADE!

TRANSISTORIZED DC POWER!
HI-EFFICIENCY DC to DC to 450 VDC
"TABSTAT" KIT or BUILT!

Output 450 & TAP 250VDC at up to 150 MA/Up to **70 Watts** 80% efficiency: ripple 0.2%; low idle current one amp silicon rectifiers, oil condensers, toroid transf. fused & short circuit proof. Regulation 5% at 20 to 100% load!! **Small in size! Quiet! Light wgt! Low-priced qtd "TABSTAT" TR1245CB built $35. Pre-Assembled U-Build kit TR1245CK Only $30.** Six V Inpt. TR645CB **$35** or Kit TR645CK **$30.** "TABSTAT" 250VDC @ 100MA/12V Inpt in TR1225CB **$27.** Kit TR1225CK **$24,** 6V inpt TR6125CB **$27,** Kit TR625CK **$24.**

KITS! "TAB" *THE BEST KITS!*

All Kits Contain Most Popular Values & Sizes

Kit 2 Eng. Parallel Rules	Kit 5 Sub-Min Tubes
Kit 35 Precision Resistors	Kit 40 Standoff Insulators
Kit 45 Switches	Kit 35 Power Resistors
Kit 75 Resistors ½/1½W	Kit 75 Mica Condensers
Kit 150 Carbon Resistors	Kit 5 Crystal Diodes
Kit 25 Panel Lamps	Kit 100 Fuses, Assorted
Kit 12 Electrolytic Cond's	Kit 100 Ceramic Condsr.
Kit 56 Tube Sockets	Kit 10 Germanium Diodes
Kit 65 Tubular Cond'sers	Kit 5 FT243 Xtal Holders
Kit 500 Lugs & Eyelets	Kit 8 Silicon Diodes
Kit 10 Bathtub Oil Cond's	Kit 5 Microswitches
Kit 5 lbs. Surprise Pckg.	Kit 4 Asstd Rectifiers
Kit 10 Xmttr Mica Condsr.	Kit 2 PNP Transistors
Kit 3 Phone/Patch Xfmrs	Kit 4x50 Ft Hookup Wire
Kit 3 Searchlights	Kit 2 Vveder Counters
Kit Circular Slide Rule	Kit 2—Computer Toroids
Kit 12 Algtr Clip Asst'd.	Kit High Gain XTAL Mike

BUY 10 KITS—GET ONE FREE! **EACH KIT 99¢**

LO PRICED NEW SILICON 500MA RECTIFIERS GTD!
Input Working Range RMS/ACV Res. or Cap.

rms/piv 35/50 30¢	rms/piv 70/100 45¢	rms/piv 140/200 50¢	rms/piv 210/300 65¢
rms/piv 280/400 75¢	rms/piv 350/500 $1.00	rms/piv 420/600 $1.20	rms/piv 490/700 $1.50
rms/piv 560/800 $1.59	rms/piv 630/900 $1.89	rms/piv 700/1000 $2.58	rms/piv 770/1100 $3.12

Use in Bridge or C.T. up to 750ma dc

General Purpose 360PIV @ 250Ma or 252VRMS "TGP"
Special 2 for $1; 25 for $10, 100 for $36.

**Postpaid 48 states TopHats only!*

NEW DC POWER for TRANSISTORS!!

New low-cost 25 volt one amp filtered 1½ Ripple Power Supply. Same as specified in Transistor Manuals **G.E., RCA, CBS.** Ideal for powering transistor circuits, rugged & small in size! Preassembled kit U-build B25VIACK $10, or assembled B25VIACB **$12.**

"TAB" BARGAINS—YOUR BEST BUY!

BC696/3 to 4 Mc's Xmttr Good Condition.....$5.95
AN—ARR2/Rcvr As Is Good for Parts.....$1.59
RDZ/USN 200-400 Mc's Rcvr less Tubes.....$25.00
RAX/Rcvr covers 4 Bands 1 to 9 Mc's Super Het 8 tubes, has BFO Vernier Ltd Qty!.....$24.00
BC653/100 to 200W Xmttr Phone or Cw 2 to 4.5 Mc's includes 12V/Dynmtr 5 Channels.....$39.00
"Irish" Tape 1200' Hi-Qlty and $1.59 @.....6 for 59
"Irish" Tape Mylar 2400 ft Best Qlty $4.49, 3/$12
Snooperscope Tube 2" $5 @.....2/59
2N277 $4.50; 2N278 $5.50; 2N441 $3; 2N442 $5.

NEW "TEKSEL" SELENIUM RECTIFIERS

FULL WAVE BRIDGE RECTIFIERS. *ONE YEAR GTD!*

AMP. CONT.	18VAC 14VDC	36VAC 28VDC	72VAC 56VDC	144VAC 118VDC
1AMP	$ 1.30	$ 2.00	$ 4.90	$ 9.45
2AMP	2.15	3.00	9.25	16.75
3AMP	2.90	4.00	8.60	16.75
6AMP	4.15	8.00	18.75	36.15
10AMP	6.10	12.15	26.30	48.90
15AMP	9.90	19.00	40.00	76.60
24AMP	15.00	29.45	57.50	108.45

***NEW* Selenium Radio & TV Rectifiers! GTD.**
65Ma 45¢, @ 6 for $2; 100Ma 45¢ @, 12/$5,
250Ma 65¢ @; 10/$8, 300Ma 88¢ @; 10/$8,
500Ma $1 @, 10/$8, 25/$18
Orders of $10 or More, Postpaid 48 states! *This Item only.*

"TAB" 111GA LIBERTY ST., N.Y. 6, N.Y.

TERMS: Money Back Guarantee! Our 15th year. $2 min. order F.O.B. N.Y.C. Add shpg charges or for C.O.D. 25% Dep. Prices shown subject to change.

Send 25c PHONE: RECTOR 2-6245 *for Catalog*

NEW LITERATURE *(Continued)*

52 contacts are shown in this 4-page catalog sheet of Amphenol connectors.—**Schweber Electronics,** 60 Herricks Rd., Mineola, N. Y.

MULTIPLIER PHOTOTUBES are thoroughly explained, their applications described and typical circuits given in the 72-page second edition of *Multiplier Photo-Tubes* — **Industrial Tube Sales Div., A. B. DuMont Laboratories, Inc.,** Clifton, N. J. **$1.**

ANTENNA CATALOG includes technical data, pickup patterns, detailed drawings of over 40 antennas for Government, commercial and amateur service, along with towers, baluns and rotation and indication systems. *Technical Data and Catalog* has 41 pages.—**Telrex Laboratories,** Asbury Park 25, N. J.

MICROMHOMETER for professional tube testing is pictured and described in this 8-page brochure. *Model WT-100A* details are in booklet 3F771.—**Commercial Engineering Dept., RCA Electron Tube Div.,** 415 S. 5th St., Harrison, N. J.

SWITCHING TRANSISTORS for medium and high speeds are listed with full characteristics and typical operating conditions in the 24-page booklet *Medium and High-Speed Switching Transistors.* — **Sylvania Electric Products Inc.,** 1100 Main St., Buffalo, N. Y.

VOLTAGE REGULATORS with transistor electronics, *IET series* (Instantaneous Electronic Transistorized) are shown with ratings, dimensions and weights in 8-page bulletin *SE-L2596. IET Stabiline* units have input range of 95–135 volts and adjustable output of 110–120 volts.—**Superior Electric Co.,** Bristol, Conn.

DIALS, DRIVES, POINTERS and associated mechanisms including planetary drives and vernier dials are shown with dimensions in 8-page *Bulletin 59-6.*—**National Radio Co., Inc.,** 37 Washington St., Melrose 76, Mass.

ASSEMBLY TOOLS for electronic bench work, including special screw and nut drivers; many styles of tweezers; various pliers, cutters and nippers; special soldering and holding aids are shown in a 16-page catalog *Component Assembly Tools and Instruments.*—**R. N. Hunter Sales Co., Inc.,** 9851 Alburtis Ave., Santa Fe Springs, Calif.

AMPLIFIER MEASUREMENTS, new booklet prepared by Institute of High Fidelity Manufacturers committee, is the second in the institute's series of high-fidelity component standards. It follows the earlier *Standard Methods of Measurements for Tuners.* — **IHFM,** 125 E. 23rd St., New York 10, N. Y. **$1.**

SPECTRUM ANALYZERS, curve tracers, sweep-frequency generators and special-purpose instruments for ultrasonic and microwave study are detailed in a 12-page *Catalog Digest.* — **Panoramic Radio Products, Inc.,** 520 S. Fulton Ave., Mount Vernon, N. Y. END

ONE CENT SALE

BUY ONE AT OUR REGULAR LOW PRICE AND GET THE SECOND FOR ONLY 1¢ MORE

CITIZENS BAND TRANSMITTER (27 MC) chassis complete with crystal. $12.49 each, two for $12.50.

TRANSMITTER similar to above but with 5 watt RF stage instead of 1 watt. $14.99 each, two for $15.00.

CITIZENS BAND RECEIVER chassis turnable through all 22 channels. Complete with audio amplifier. $9.99 ea., two for $10.00.

AMATEUR BAND TRANSCEIVER (144-148 MC) chassis with dual VHF triodes for walkie-talkie radiophone. $9.99 ea., two for $10.00.

TRANSCEIVER TRANSFORMER: Mike to grid input and plate to low impedance headphone output. Good for telephone handsets. $1.99 pair, two for $2.00.

TELEPHONE HANDSETS with push-to-talk switch. $5.99 each, two for $6.00.

MICROPHONE High output 200 ohm carbon with terminal lugs. $1.49 ea., two for $1.50.

COILED CORD 4 conductor 11" telephone cord. Extends to over 4 ft. .99 ea., two for $1.

KIT OF PARTS for AM-FM VHF radio receiver. Tunable from 80-200 mc. which includes U. S. satellite frequencies. $6.99 ea., two for $7.00.

TRANSISTOR AUDIO AMPLIFIER gives 50X voltage gain on low level signals. Operates on 1½ volts. $3.99 ea., two for $4.00.

CONVERTER (Crystal controlled) for 27 MC Citizens Band. Adapts any standard broadcast radio to 27 MC band. Tunes all 22 channels. Complete with tubes and crystal. $14.99 each, 2 for $15.00.

TRANSMITTER CRYSTALS in holders. Assorted frequencies for experimenters. Bag of 10 only $1.49—two bags for $1.50.

ALL MERCHANDISE GUARANTEED

LIMITED QUANTITY—
NO LITERATURE OR CATALOG

Remit in full. Include sufficient postage. No C.O.D.'s.

VANGUARD ELECTRONIC LABS.

Box 12-RE-1 **Hollis 23, N.Y.**

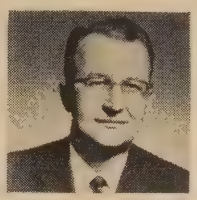
MOVING?

If you're moving please don't forget to send us your old address as it appears on your latest copy of the magazine. Include the numbers shown beside your name. If possible, send us the actual address label which is pasted on the lower right hand corner of the front cover. Be sure to include your postal zone number (if any) with your new address. If we receive this information before the 20th of the month, you will continue to get RADIO-ELECTRONICS without interruption.

Please send data to
Circulation Department

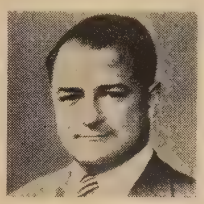
Radio-Electronics
154 West 14th Street • New York 11, N. Y.

BUSINESS and PEOPLE



Edward J. Danneberg was elected to the new post of vice president for personnel of Tung-Sol Electric, Newark, N. J. He had been director of industrial relations.

E. Leslie Peter was appointed sales manager of the newly formed Canadian division of Tung-Sol Sales Corp., with offices in Montreal. He has served with Tung-Sol in various managerial capacities since 1957.



Raymond T. Leary was appointed general sales manager of Cornell-Dubilier Electric Corp., South Plainfield, N. J. He had been vice president and sales manager of the Distributor Div.

Joseph Ferrante joined the company as research director in dielectrics at the new research laboratory in Norwood, Mass. He comes to Cornell-Dubilier from Tobe Deutschmann Corp.

K. B. (Ken) Price joined Merit Coil & Transformer Corp., Hollywood, Fla., as sales manager. He comes from Sprague Products Co., where he was regional sales supervisor.

David H. McGalliard joined the Daystrom-Weston Sales Div. of Daystrom, Inc., Murray Hill, N. J., as distributor sales manager. He'd been with Remington Rand.

R. Edward Lawrence was appointed manager, industrial tubes and semiconductors-Merchandising, for RCA Electron Tube Div.'s Distributor Products Dept., Harrison, N. J. He had been manager, merchandising-semiconductor products for the department.

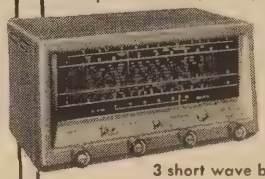
Special Offer 25¢

Hear these authentic recordings of dramatic events from

"The Amazing World of Short Wave Listening"

narrated by Alex Dreier, Radio-TV "Man on the Go"

- President's voice from outer space!
- Actual capture of a desperate criminal!
- Radio amateur at Little America!
- Ships at sea . . . aircraft in action!



S-38E receiver **$59.95**

3 short wave bands plus standard broadcast. Built-in speaker, headset output.

MAIL COUPON TODAY!

hallicrafters.

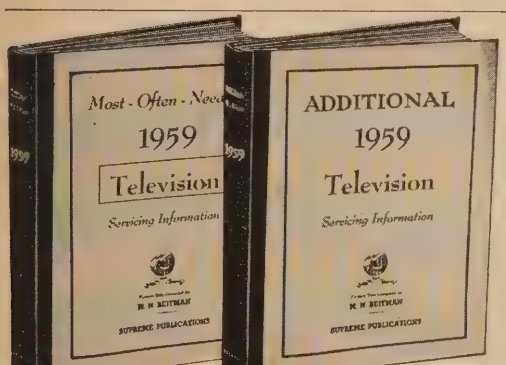
DEPT. 23, CHICAGO 11, ILL.

Gentlemen: Please rush by return mail my recording, "*The Amazing World of Short Wave Listening.*" I enclose 25¢.

NAME_____

ADDRESS_____

CITY_____ STATE_____



These *two* **1959 TV** volumes cover practically all sets of all makes. The new ADDITIONAL **1959 TV** manual includes material almost to the minute. Each giant manual has 192 pages of service data and repair hints, factory changes, double-size circuits. Special price, each only.. **$3**

New ADDITIONAL 1959 TV Volume

LARGE MANUAL COVERS NEWEST 1959 TV SETS
EARLIER TV VOLUMES STILL SOLD AT ONLY $3

AMAZING BARGAINS

Supreme twin **1959 TV** manuals are the scoop of the year. Cover all sets of all important makes. New ADDITIONAL **1959 TV** volume gives you the very latest material. Your price for this mammoth manual is only **$3.** *Supreme* super values defy competition. Each prior-year manual (at only $3) has a whole year of service material. Each volume covers different material, from 1948 to latest 1959 sets. Include circuits, waveforms, alignment, voltage charts, service hints, changes, and double-spread diagrams. Practically tell you how to make every repair. More pages, more diagrams, more service data per dollar of cost. To get the best for less, get *Supreme* manuals.

Supreme **TV** manuals supply all needed service material on every TV set of every important manufacturer. Here is helpful, practical, factory-prepared data. It will really make TV servicing and adjustment easy for you. Join 167,000 servicemen who use, benefit, and save with SUPREME service manuals. In these volumes you get correct factory-checked circuits, alignment procedure, printed boards views, service hints, recommended changes, wave-forms, voltages, easy-to-use giant-size diagrams.

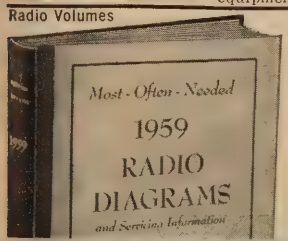
BEST AT LOWEST COST

Here is your TV service material to help you do expert work double-quick; and priced at only $3 per annual volume. Be ready to repair any model by carrying in your car all 14 TV volumes listed in coupon below. Or try one of the new **1959 TV** manuals to see what an amazing bargain you get for only **$3.** See *no-risk* coupon.

TELEVISION SERVICING COURSE

Let this new course help you in TV servicing. Amazing bargain, complete, only $3, full price for all lessons. Giant in size, mammoth in scope, topics just like a $200.00 correspondence course. Lessons on picture faults, circuits, adjustments, short-cuts, UHF, alignment facts, hints, antenna problems, trouble-shooting, test equipment, picture analysis. Special, only **$3**

Radio Volumes



RADIO DIAGRAMS

Supreme is your best source for all needed RADIO diagrams and service data. Covers everything from the most recent 1959 radios to pre-war old-timers; home radios, auto sets, combinations, changers, stereo, FM, and portables. Sensational values. Only $2 for many volumes. Every manual has extra large schematics, all needed alignment facts, printed boards, voltage values, trimmers, dial stringing, and helpful hints. Volumes are large in size 8½x11 inches, about 190 pages. See coupon at right for a complete list of these radio manuals. →

Supreme Publications

Sold by All Leading Parts Jobbers

NO-RISK TRIAL ORDER COUPON

SUPREME PUBLICATIONS, 1760 Balsam Rd., Highland Park, ILL.

☐ 1959 ☐ 1958 ☐ 1957 ☐ 1956 } Popular RADIO Diagram Manuals at only $2.50 each....

☐ 1955 Radio Manual, only $2

☐ 1954 ☐ 1953 ☐ 1952 ☐ 1951 ☐ 1950 ☐ 1949 } These annual RADIO volumes specially priced at only $2.50 each....

☐ 1948 ☐ 1947 ☐ 1946 ☐ 1942 ☐ 1941 ☐ 1940 } THIS GROUP ONLY $2 EACH

☐ 1926-1938 Manual, $2.50

☐ Radio and TV Master Index, 25¢

Rush today TV manuals checked ☒ below and Radio manuals at left. Satisfaction guaranteed.

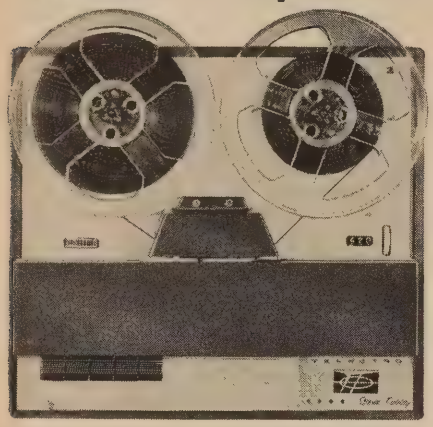
☐ *New* **Additional 1959 Television** Manual, only **$3.**
☐ **Early 1959 Television** Manual, **$3.** ☐ **1958 TV, $3.**
☐ **Early 1957 TV, $3.** ☐ **Additional 1957 TV, $3.**
☐ **1956 TV** Manual, **$3.** ☐ **Additional 1955 TV, $3.**
☐ **Early 1955, $3.** ☐ **1954 TV, $3.** ☐ **1953 TV, $3.**
☐ **1952 TV, $3.** ☐ **1951 TV, $3.** ☐ **1949 TV, $3.**
☐ **1948 TV, $3.** ☐ **1957-58 RCA TV** Manual, **$1.50**
☐ *New* **Television Servicing Course,** complete. . . . **$3.**

☐ I am enclosing $..... Send postpaid.
☐ Send C.O.D. I am enclosing $.....deposit.

Name: .....

Address: .....

TELECTRO Series 900 Stereo Tape Deck



ADDS VERSATILITY...

3-speeds, 4-track head for every kind of stereo and monaural tape, with interchangeable head assemblies. Stereo and monaural recording and playback facilities.

CONVENIENCE...

Unique pushbutton controls for fast, positive tape handling. Special brake design permits easy reel rotation. Solenoid operated auto shut-off.

ENJOYMENT...

Twenty, fifty, five hundred playings from now, your tapes will still sound clean, crisp, mint-fresh, long after discs have developed pops and scratches.

ECONOMY...

You can add a Telectro Stereo Tape Deck **for as little as $89.95.** There are five models in all, one perfectly suited to <u>your</u> requirements.

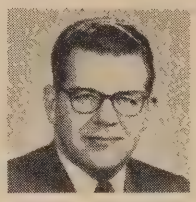
TO YOUR HIGH FIDELITY SYSTEM

Telectro also makes a complete line of tape preamplifiers, design-mated for use with Telectro tape decks. See the Telectro Series 900 stereo tape decks at your high fidelity dealer. For further information, write Dept. R-1.

TELECTRO

a product of **TELECTROSONIC Corp.**
35-28 - 37th Street
Long Island City 1, N. Y.

Supreme Electronics Corp., subsidiary of Hickok Electrical Instrument Co., broke ground for a 25,000-square-foot addition to its plant in Greenwood, Miss. R. D. Hickok, president of Hickok, and David Hughes, director of marketing (second and third from right), attended the ground-breaking ceremonies along with E. G. Perkins, president of Supreme (second from left), and local civic officials.



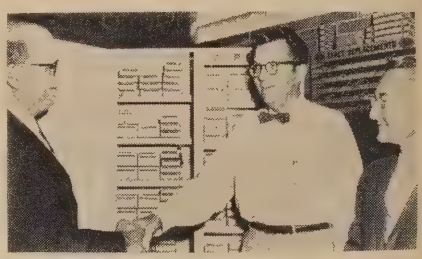
Donald L. Mauer was named a sales engineer for Triplett Electrical Instrument Co., Bluffton, Ohio. He joined the sales staff of the company last summer and has an extensive background in electronics sales work.

Carl L. Sundberg was named distributor sales manager for Oxford Components, a division of Oxford Electric Corp., Chicago. He had been with Oxford in various departments including production, expediting, and in a supervisory capacity in all phases of manufacturing and engineering.

Don Kirkendall was appointed assistant manager of advertising and sales promotion of Electro-Voice, Inc., Buchanan, Mich. He had been with Interstate Electronics Supply Corp. He succeeds **Dean Nordquist** who was recently named assistant sales manager of the Electro-Voice Cartridge & Needle Div.

Thomas E. Gootée joined Page Communications Engineers, a subsidiary of Northrop Corp., Washington, D. C., as assistant director of maintenance and operations. He accepted the position after a 17-year civilian–military career with the Army, where he was in communications–electronics work since World War II, most recently as civilian liaison official for the Office of the Chief Signal Officer.

Aerovox, New Bedford, Mass., awarded first prize in its "Name This Cabinet" contest held at the Parts Show in Chicago in May, to Doug Ealy, purchasing agent for Southwest Wholesale Radio, Inc., Phoenix, Ariz., who suggested the name "Capaci-Door." The winner received a cabinet with $500 worth of Aerovox electrolytic capacitors



as his prize. Matt Simon (left), sales manager for the Aerovox Distributor Div., is shown making the award while Verne Linsley, area sales representative, looks on.

Reed Waldron was promoted to sales promotion manager of the Distributor Div. of International Resistance Co., Philadelphia, Pa. He has been on the staff since 1955, most recently as promotional assistant in the Distributor Div.

Harold Seagren joined Audiotex Mfg. Co., Division of G-C-Textron, Rockford, Ill., as Eastern sales manager. He was formerly with F. W. Means & Co.

EIA PRODUCTION AND SALES

(first 9 months)	*1959*	*1958*
TV set production	4,488,857	3,572,189
Radio production	10,927,252	7,686,197
FM radio production	367,804	176,061
TV retail sales	3,811,754	3,468,090
Radio retail sales	5,285,878*	4,556,545*
Receiving tube factory sales	315,797,000	291,718,000
Picture tube factory sales	6,857,682	5,844,665

*Excluding auto receivers

Lewis T. Stein, merchandising assistant in the Industrial Components Div. of Allied Corp., Chicago, was promoted to the position of product merchandiser. END

DEALERS SERVICEMEN
TUBE TESTER ROUTE OPERATORS
EXPERIMENTERS
HAMS

with ZALYTRON QUALITY BRAND RADIO & TELEVISION RECEIVING TUBES

BRAND NEW
INDIVIDUALLY BOXED
In Famous Green & Black Carton

GUARANTEED FOR ONE YEAR

We will replace all defective tubes within 12 months from date of purchase, excepting only burned out or broken tubes. Standard Customer Warranty 90 Days.

You "play ball" with "MAJOR LEAGUERS" when you buy ZALYTRON Tubes! "Tubes" are OUR MIDDLE NAME! We have been supplying tubes for many years to service dealers and Tube Tester Route Operators . . . and the ZALYTRON Brand name has achieved a reputation for quality and performance, second to none!

Yes, you "play it SAFE" with Zalytron because you get BRAND NEW Tubes:

• NOT USED • NOT PULLED from equipment **• NOT REJECTS**

but Zalytron's First Quality! And, important too: by selling DIRECT to the electronics trade, we pass the middleman's profit on to our customers . . . helping them to meet and beat competition in their areas.

SEND IN A TRIAL ORDER TODAY! You'll be delighted with our speedy service — and in due time you will join our host of customer friends who rank ZALYTRON as a First Class Source of Supply for Tubes. Your Trial Order will be shipped on our **FULL MONEY BACK GUARANTEE!** Try ZALYTRON Tubes at **OUR** Risk, and **JUDGE FOR YOURSELF!**

TYPE	EACH	TYPE	EACH	TYPE	EACH	TYPE	EACH	TYPE	EACH
OZ4	$ .85	5CQ8	1.30	6BF5	1.35	6DQ6	1.10	12AV6	.60
1AX2	.70	5J6	.75	6BF6	.55	6DT6	.60	12AV7	.85
1B3	.95	5T8	.86	6BG6	2.25	6J5	.70	12AX4	.95
1S5	.60	5U4G/GB	.75	6BH6	.70	6J6	.60	12AX7	.65
1T4	.55	5U8	.75	6BH8	.90	6K6	.80	12B4	.70
1U4	.45	5V6	.55	6BJ6	.65	6L6	1.15	12BA6	.60
1U5	.55	5Y3GT	.55	6BK5	1.40	6S4	.60	12BD6	.60
1X2A/B	.95	6AB4	.55	6BK7A/B	.90	6SA7	.80	12BE6	.60
2AF4	1.00	6AC7M	.90	6BL7	1.55	6SC7	.80	12BH7	.80
3AF4	1.05	6AF4	1.05	6BN6	.75	6SK7	.75	12BQ6	1.10
3AL5	.46	6AG5	.65	6BQ5	.70	6SL7	.90	12BY7	.80
3AU6	.55	6AG7M	1.25	6BQ6	1.10	6SN7	.85	12C5	.60
3AV6	.45	6AH4	1.30	6BQ7A	1.10	6SQ7	.85	12CU5	.60
3BN6	.75	6AH6	1.35	6BR8	.95	6T4	1.00	12CU6	1.10
3BU8	.75	6AK5	.85	6BU8	.70	6T8	.95	12DQ6	1.10
3BY6	.60							12F8	.65
3BZ6	.60							12K5	.70
3CB6	.60							12L6	.65
3CF6	.65							12SA7	1.00
3CS6	.60							12SK7	.85
3DT6	.55	6AL5	.55	6BX7	1.65	6U8	.85	12SN7	.90
3Q4	.65	6AM8	.85	6BY6	.60	6V6	.80	12SQ7	.90
3S4	.65	6AN8	.95	6BZ6	.65	6W4	.80	12V6	.55
3V4	.70	6AQ5	.55	6BZ7	1.10	6W6	.95	12W6	.75
4BC8	1.00	6AS5	.90	6C4	.50	6X4	.45	12X4	.45
4BN6	.75	6AT6	.55	6CB6	.70	6X5	.65	19AU4	.85
4BQ7A	1.10	6AT8	.85	6CD6	1.70	6X8	.85	19T8	1.00
4BS8	1.00	6AU4	1.00	6CF6	.70	6Y6	.95	25AX4	1.15
4BZ7	1.10	6AU5	1.75	6CG7	.65	8AU8	.90	25BQ6	1.10
4CB6	.60	6AU6	.65	6CG8	.80	8AW8	.95	25CD6	1.50
4DT6	1.00	6AU8	.90	6CL6	1.35	8CG7	.65	25CU6	1.10
5AM8	.80	6AV5	1.60	6CM7	.70	10DE7	1.15	25DQ6	1.10
5AN8	.85	6AV6	.55	6CN7	.70	11CY7	.75	25L6	.85
5AQ5	.55	6AW8	.90	6CQ8	1.35	12AD6	.55	25W4	1.10
5AT8	.85	6AX4	.95	6CS6	.70	12AF6	.60	35C5	.65
5AU4	.95	6BA6	.65	6CS7	1.15	12AQ5	.56	35L6	1.00
5BK7	.90	6BC5	.60	6CU5	1.00	12AT6	.60	35W4	.50
5BQ7	.98	6BC8	1.10	6CU6	1.10	12AT7	.76	35Z5	.70
5CG8	.85	6BD6	.65	6CY7	.75	12AU6	.60	50C5	.70
5CL8	.80	6BE6	.55	6DE6	.70	12AU7A	.70	50L6	.75

WE PAY ALL SHIPPING CHARGES
on all orders accompanied by remittance in full.

Above is only a partial listing of our huge tube stocks. Send today for FREE Complete up-to-date Tube Price List and Catalog. We Ship all Orders COMPLETE Same Day Received! C.O.D. ORDERS: 25% Deposit with order, balance C.O.D. plus all shipping charges. MINIMUM ORDER (Special for This Ad) $5.00.

ZALYTRON TUBE CORPORATION
220 West 42nd Street New York 36, N. Y.
Telephone: BRyant 9-2542 DEPT. RE-1

FREE!
Giant New Wholesale Catalog of Radio & TV Receiving Tubes, Electronic Components. **Free on Request.**

THIS MONTH'S SPECIAL

GET THIS DELUXE SHELL 102
TEST-O-MATIC SELF-SERVICE
TUBE TESTER
(Nationally Advertised by the Factory at a Net Cost of $199.95)

PLUS ZALYTRON "PACKAGE DEAL" OF
150 RADIO & TV RECEIVING TUBES

COMPLETE FOR ONLY **$245.00** F.O.B., NYC.

102 SOCKETS

When you buy our "Package Deal" you are, in effect, getting with it a Stock of Tubes, worth $450 retail, FOR ONLY $45.00 — **which is actually 90% discount!**

Quan.	Type	Quan.	Type	Quan.	Type	Quan.	Type
1	0Z4	5	6AQ5	5	6CB6	2	12AT7
3	1B3	1	6AS5	1	6CD6	5	12AU7A
1	1R5	1	6AT6	1	6CG7	1	12AV6
1	1S5	1	6AT8	1	6CM7	1	12AX7
1	1T4	5	6AU6	2	6CU6	1	12B4
1	1U4	1	6AU8	1	6DQ6	3	12BA6
1	1U5	1	6AV6	5	6J6	1	12BE6
3	1X2A/B	1	6AW8	1	6K6	2	12BH7
1	3CB6	2	6AX4	1	6S4	1	12BQ6
1	3V4	3	6BA6	1	6SA7	1	12BY7
1	5AM8	1	6BC5	1	6SK7	1	12CU6
1	5AQ5	1	6BC8	5	6SN7	1	12SA7
1	5J6	2	6BE6	1	6SQ7	1	12SK7
3	5U4G	1	6BG6	1	6T8	1	12SN7
1	5U8	1	6BH6	5	6U8	1	12SQ7
2	5Y3	1	6BJ6	2	6V6	1	25BQ6
1	6AC7M	1	6BK7A	2	6W4	1	25CU6
3	6AG5	1	6BN6	1	6W6	1	25L6
1	6AH6	2	6BQ6	1	6X4	2	35W4
1	6AK5	2	6BQ7A	1	6X5	1	35Z5
5	6AL5	1	6BZ6	2	6X8	2	50C5
1	6AM8	2	6BZ7	1	7AU7	2	50L6
1	6AN8	1	6C4	1	12AT6		

To ZALYTRON Tube Corp., DEPT. RE-1
220 West 42nd Street, New York 36, N. Y.
☐ Send FREE 1960 Catalog.

NAME_____

ADDRESS_____

CITY_____ ZONE___ STATE_____

IF YOU USE A SOLDERING GUN YOU NEED AN ESICO

GUNCHOKE®

SOLDER WITH CONFIDENCE !

NOW . . . USE YOUR SOLDERING GUN FOR THE PURPOSES IT WAS ORIGINALLY INTENDED— QUICK HEATING . . . QUICK COOLING.

GUNCHOKE
reduces tip temperature to 500° or 600°—the correct temperature for soldering printed circuits and laminated wiring boards.

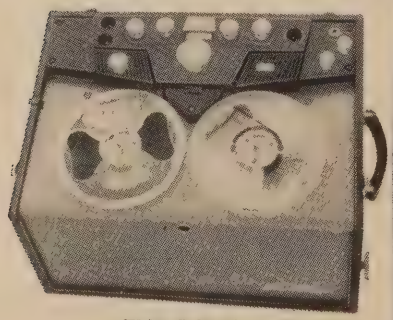
THERE'S A GUNCHOKE FOR YOUR GUN

Buy From Your Distributor

Electric Soldering Iron Co., Inc.
759 W. Elm Street Deep River, Conn.

"Forget that lousy ruby, Ed. Let's pry this Jensen cartridge loose."

WHERE THERE'S A FINE TAPE RECORDER... there's **irish** BRAND *ferro-sheen tape*



note to **EKOTAPE** *owners*

To insure optimum recording quality with your excellent machine, the recommended tape is **irish** *#211 ...and for maximum performance on a budget-priced tape,* **irish** *#195 offers superior frequency response backed by the famous* **irish** *guarantee. Send for technical bulletin.*

ORR INDUSTRIES INC.
Opelika, Alabama

new BOOKS

MISSILES AND SATELLITES, by David Mark. Cowan Publishing Corp., 300 W. 43 St., N. Y. 36, N. Y. 6 x 9 in. 96 pp. $1.50.

Space travel is such an interesting and mysterious topic that it is sometimes difficult to tell where truth ends and fiction begins. Here is a factual account that will make good reading for technicians and laymen. It tells of missiles, from the early Chinese rockets to the present.

Part 1 is about missiles, Part 2 about satellites. They explain flight control, range, propellants, nose cones, and the latest methods for launching and tracking. Photos show 38 modern missiles, and their characteristics. The book ends with present plans to reach the moon, erect space platforms and build space ships.

TRANSISTORS IN RADIO, TV AND ELECTRONICS by Milton S. Kiver. McGraw-Hill Book Co., Inc., 330 W. 42 St., N. Y. 36, N. Y. 6 x 9 in. 424 pp. $7.95.

This new edition will bring the technician up to date on transistor practice and use. It begins with basic theory of semiconductors, showing what they are and how they work. Subsequent chapters describe their applications. Practical circuits are given, many with actual component values.

The author discusses recent developments in transistors, service techniques, amplifier design and gives a number of experimental circuits that the reader may build. A thorough exposition for the serious practical experimenter and technician.—*IQ*

BASIC ELECTRONIC TEST PROCEDURES, by Rufus P. Turner. Rinehart & Co. Inc., 232 Madison Ave., N. Y., N. Y. 9½ x 6¼ in. 316 pp. $6.50.

Radio, television, hi-fi, computers or space-borne electronics—the problems involved in testing such equipment are the same. This well illustrated basic text clearly shows, through the use of step-by-step instructions, how to measure all kinds of electronic phenomena. Subjects from the correct use of meters to transmitter tests and measurements are included. A special chapter at the end of the book shows how industrial electronic measurements are made.—*LS*

PIN-POINT TRANSISTOR TROUBLES IN 12 MINUTES, by Louis E. Garner, Jr. Coyne Electrical School, 466 W. Superior St., Chicago 7, Ill. 5½ x 8 in. 478 pp. $5.95.

When a radio comes into the shop for quick repair, we need service data, troubleshooting suggestions and alignment procedure. Such information is found here on radios, amplifiers, and TV. Control and test instruments are also described.

The manual covers auto and portable

(*Continued on page* 156)

SCHOOL DIRECTORY

CODE SENDING RECEIVING SPEED

Be a "key" man. Learn how to send and receive messages in International Morse code. Communicate with operators around the globe. Learn at home quickly through famous Candler System. Used by best operators. Qualify for Amateur or Commercial License. Write for FREE BOOK.

CANDLER SYSTEM CO.
Dpt.3-A, Box 9226, Denver 20, Col. USA

GET INTO ELECTRONICS

V.T.I. training leads to success as technicians, field engineers, specialists in communications, guided missiles, computers, radar and automation. Basic and advanced courses in theory and laboratory. Assoc. degree in electronics in 29 mos. B.S. in electronic engineering obtainable. ECPD accredited, G.I. approved. Graduates in all branches of electronics with major companies. Start February, September, Dorms, campus. High School graduate or equivalent. Catalog.

VALPARAISO TECHNICAL INSTITUTE
Dept. C Valparaiso, Indiana

Learn Transistor Electronics At Home!

■ Prepare now for a profitable career in this growing field. Learn theory, construction and applications of all types of transistors with this proven home-study course from the Philco Technological Center.

FOR FREE INFORMATION PLEASE WRITE TO:
PHILCO®
TECHNOLOGICAL CENTER
"C" and Ontario Sts., Philadelphia 34, Pa.

ELECTRONICS

Prepare for unlimited opportunities in electronics!
ENGINEERING DEGREE IN 27 MONTHS
B.S. Engineering degree (27 mo.): Mathematics, Electrical Engineering, TV, advanced Radio Theory and Design. **B.E. (36 mo.):** Aeronautical, Chemical, Civil, Electrical, Mechanical, Metallurgical Eng. **B.S. (36 mo.):** Math., Chem., Physics. Also preparatory courses. Earn board. G.I. approved. 20 bldgs., dorms, gym. Enter March, June, Sept., Dec. Catalog. **Keeping pace with progress.**
INDIANA TECHNICAL COLLEGE
1510 E. Washington Boulevard, Fort Wayne 2, Indiana

Electronics Engineering Degree in 27 Months

Realize your dream. Become a graduate engineer. Share rewards awaiting college men . . . higher income, rapid advancement. Important firms regularly visit Tri-State College to interview seniors. Founded in 1884.

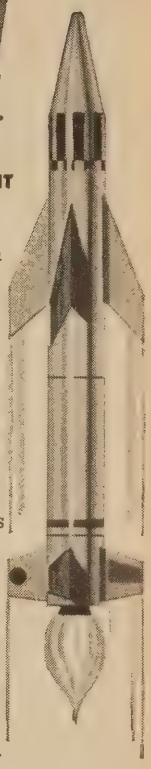
Electronics or Power Major

Bachelor of Science Degree in 27 Months in Electrical, Mechanical, Civil, Chemical, Aeronautical Engineering. *In 36 Months* a B.S. in Business Administration (General Business, Accounting, Motor Transport Management majors). For earnest, capable students. Small classes. Enrollment limited. More professional class hours. Mature students. Well-equipped labs. Modest costs. Beautiful campus. Year-round operation. Enter Mar., June, Sept., Jan. *Write J. G. McCarthy, Director Admissions, for Catalog and "Your Career" Book.*

TRI-STATE COLLEGE
2410 College Avenue, Angola, Indiana

prepare for your career in

ELECTRICAL ENGINEERING
ELECTRONICS
COMPUTERS
RADIO-TV



At MSOE, you can equip yourself for a career in many exciting, growing fields: **MISSILES RADAR • AUTOMATION RESEARCH • DEVELOPMENT ELECTRICAL POWER AVIONICS • ROCKETRY**

When you graduate from the Milwaukee School of Engineering, you are prepared for a dynamic career as an Electrical Engineer or Engineering Technician. Under a faculty of specialists, you gain a sound technical education in modern, completely equipped laboratories and classrooms. As a result, MSOE graduates are in great demand and highly accepted by industries nationally.

At MSOE you will meet men from all walks of life and all parts of the country — some fresh out of high school or prep school, others in their twenties — veterans and non-veterans.

You can start school in any one of four quarters and begin specializing immediately. Engineering technicians graduate in 2 years with an *Associate* in *Applied Science* degree. For a *Bachelor of Science* degree in Engineering, you attend 4 years. A 3-month preparatory course also is available.

FREE CAREER BOOKLET! If you're interested in any phase of electronics, radio or television, be sure to look into the programs of study offered by the Milwaukee School of Engineering. Just mail the coupon.

MILWAUKEE SCHOOL OF ENGINEERING
Dept. RE 160, 1025 N. Milwaukee St. Milwaukee, Wisconsin

Please send FREE Career Booklet. I'm interested in ☐ Electrical Engineering;
☐ Electronics ☐ Computers
☐ Electrical Power ☐ Radio-TV
☐ Mechanical Engineering.

PLEASE PRINT

Name..... Age.....
Address.....
City..... Zone..... State.....
☐ I'm eligible for veterans education benefits.
MS-123

ENGINEERING COURSES

PACIFIC INTERNATIONAL C.A.S.

E.E.
Option Electronics or Power
Mechanical, Civil & Physics
Also in Liberal Arts & Business Administration
presented through
HOME STUDY
Resident Classes Also Available If Desired
PACIFIC INTERNATIONAL COLLEGE OF ARTS & SCIENCES
Primarily a correspondence school
5719 G, Santa Monica Blvd., Hollywood 38, Calif.

LEARN
RADAR MICROWAVES COMPUTERS—TRANSMITTERS
CODE • TV • RADIO
Phila. Wireless Technical Institute
1533 Pine St. Philadelphia 2, Penna.
A Non-Profit Corp. Founded in 1908
Write for free Catalog to Dept. R12-59

FREE! ELECTRONICS BOOKS

I.C.S. will send you FREE 3 valuable booklets that tell you where the big-pay jobs are in Radio-TV Electronics . . . who are the industry's most-wanted men . . . how you can "cash-in" in a big way on your future. There's no obligation. Don't delay. Mail the coupon now!

INTERNATIONAL CORRESPONDENCE SCHOOLS
Dept. 40465M, Scranton 15, Penna.
Please send free success book, sample lesson, and catalog checked.

☐ General Electronics ☐ Radio-TV Serv'g ☐ Practical Electrician
☐ Industrial Electronics ☐ Sound Equipt. Serv'g ☐ Profess'l Eng. (Elec.)
☐ Radio-TV Eng'r'g ☐ Electrical Eng'r'g ☐ Electrical Drafting
☐ Electronic Servicing ☐ Electrical Tech. ☐ Other

Name..... Age.....
Address.....
City..... State.....

ELECTRONICS
PREPARE FOR A GOOD JOB!
BROADCAST ENGINEER
RADIO SERVICING AUTOMATION
TELEVISION SERVICING
BLACK & WHITE—COLOR
APPROVED FOR VETERANS AND SURVIVORS OF VETERANS
BUILDING AIR CONDITIONED
SEND FOR FREE LITERATURE
BALTIMORE TECHNICAL INSTITUTE
1425 EUTAW PLACE, BALTIMORE 17, MD.

Lafayette Superior Quality HI-FI KITS!

The FINEST . . . through research . . . engineered by LAFAYETTE!

50 WATT INTEGRATED STEREO AMPLIFIER

● RESPONSE 17-21,000 CPS ± 1 DB (at normal listening level) ● UNIQUE "BLEND" CONTROL ● PREMIUM EL86 OUTPUT TUBES ● 50 WATTS MONAURAL—25 WATTS EACH STEREO CHANNEL ● CLUTCH-OPERATED VOLUME CONTROL ● SEPARATE BASS & TREBLE CONTROLS

A completely new stereo high fidelity amplifier with a high quality of reproduction, remarkable versatility and new distinctive styling. Full range of controls include a unique "blend" control for continuously variable channel separation—from full monaural to full stereo, 4-position Selector, Mode, Loudness and Phasing switches plus outputs for 4, 8 or 16 ohm speakers. Harmonic distortion less than 0.25%, IM distortion less than 1%. Hum and Noise 74 db below full output. Assembly is simple—no special skills or tools required. Complete with deluxe cabinet and legs, all parts, tubes and detailed instruction manual. Shpg. wt., 26 lbs.

KT-250 WX Stereo Amplifier Kt..... 5.00 Down ..... Net **64.50**
LA-250 WX Stereo Amplifier, wired & tested ..... 5.00 Down ..... Net **89.50**

PROFESSIONAL STEREO CONTROL CENTER

● RESPONSE 5-40,000 CPS ± 1 DB ● UNIQUE STEREO & MONAURAL CONTROL FEATURES ● PRECISE "NULL" BALANCING SYSTEM ● CONCENTRIC INPUT LEVEL CONTROLS

A truly professional stereo preamplifier and master audio control center—solves every stereo/monaural control problem. Features unique Bridge Conrol for variable cross-channel feed for elimination of exaggerated channel separation effects—plus controlled 3rd channel output. Has all-concentric controls—including clutch-operated Volume Balance control. Provides complete and advanced facilities for accepting, controlling and providing undistorted gain for any and all program sources. Sensitivity 2.2 mv for 1 volt out (low level inputs). Dual low impedance "plate follower" outputs 1500 ohms. Response 5-40,000 cps ± 1 db. Less than .03% IM distortion. Less than .1% harmonic distortion. Hum and noise 80 db below 2 volts (high level inputs). Uses 7 new 7025 low-noise dual triodes. Size: 14" x 4½" x 10⅜". Shpg. wt., 16 lbs. Complete with all parts, tubes, deluxe cabinet and detailed instruction manual.

KT-600 WX Stereo Preamplifier Kit..... 5.00 Down ..... Net **79.50**
LA-600 WX Stereo Preamplifier, wired and tested..... 5.00 Down ..... Net **134.50**

STEREO/MONAURAL POWER AMPLIFIER KIT

● 36 WATT STEREO AMPLIFIER—18 WATTS EACH CHANNEL ● EMPLOYS 4 PREMIUM-TYPE 7189 TUBES ● 2 PRINTED CIRCUIT BOARDS FOR SIMPLIFIED WIRING ● RESPONSE BETTER THAN 35-30,000 CPS ± ½ DB AT 18 WATTS ● LESS THAN 1% HARMONIC OR IM DISTORTION

A superb basic stereo amplifier in easy-to-build kit form. Unit may be used with a stereo preamplifier to provide two 18 watt stereo channels or, at the flick of a switch, as a fine 36 watt monaural amplifier. Controls include 2 input volume controls, Channel Reverse switch and Monaural-Stereo switch. Dual outputs for 4, 8, 16 or 32 ohm speakers. Input sensitivity .45 volts per channel for full output. Tubes are 2-6AN8, 4-7189, GZ-34 rectifier. Size 10-9/16" d x 5¼" h x 13¼" w. Complete kit with cage, all parts, tubes and detailed instruction manual. Shpg. wt., 22 lbs.

KT-310 WX Stereo Power Amplifier Kit..... 2.00 Down ..... Net **47.50**
LA-310 WX Stereo Power Amplifier, wired and tested..... 5.00 Down ..... Net **72.50**

FM-AM STEREO TUNER KIT

● 11 Tubes (4 dual-purpose) + Tuning Eye + Selenium rectifier provide 17 tube performance ● Multiplex Output for new Stereo FM ● Armstrong Circuit with Dual Limiters and Foster-Seeley Discriminator ● Extreme Sensitivity and Wide Frequency Response.

A precision engineered, highly stable tuner—perfect for lifelike stereo FM-AM broadcast reception, FM reception and/or AM reception. Features separate tuning and volume controls for AM and FM. Magic eye on AM and FM, plus automatic frequency control on FM for accurate tuning—stations are "locked" in. Other deluxe features include cathode follower outputs and 5-position Function Selector. Efficient, broadband circuitry on AM with built-in antenna. FM section features include 2 microvolts sensitivity for 30 db quieting, frequency response 20-20,000 cps ± ½ db and full 200 KC bandwidth. Two printed circuit boards make wiring simple—even for such a complex unit. Complete kit includes all parts, deluxe cabinet and detailed instruction manual. Size is 13¾" W x 10⅜" D x 4½" H. Shpg. wt., 22 lbs.

KT-500 WX FM-AM Stereo Tuner Kit..... 5.00 Down ..... Net **74.50**
LT-50 WX Same as above, wired & tested..... 5.00 Down ..... Net **124.50**

LAFAYETTE 36-WATT INTEGRATED STEREO AMPLIFIER KIT

● 36-WATTS MONAURALLY—18 WATTS PER CHANNEL ● FREQUENCY RESPONSE 15-30,000 CPS ± 1 DB ● UNIQUE "BLEND" CONTROL ● CONCENTRIC CLUTCH-OPERATED VOLUME CONTROL ● DUAL CONCENTRIC BASS AND TREBLE CONTROLS ●4-EL84 TUBES IN PUSH PULL

This exciting new amplifier kit combines dual preamplifiers and dual 18 watt power amplifiers on one compact chassis. Instant selection from monophonic to stereophonic is provided by the turn of a switch. An amazing new "Blend" control gives continuously variable channel separation from full monophonic to full stereo. The concentric clutch-operated volume control offers independent or simultaneous level adjustments of both channels. Dual concentric bass and treble controls furnish 4 independent tonal adjustments. Harmonic distortion less than 0.15% at normal listening level. 1.M distortion is less than .3%. Hum and noise 70 db below rated output. Complete with cage, legs and detailed instructions. Shpg. Wt., 24 lbs.

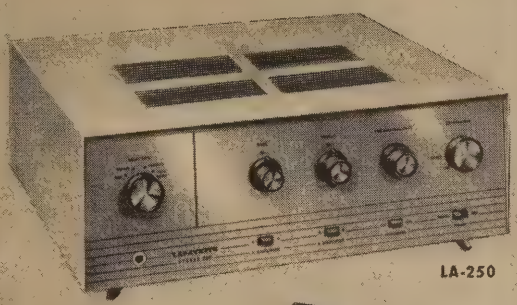
KT 236 WX Stereo Amplifier Kit..... 5.00 Down ..... Net **52.50**

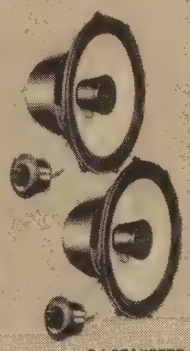
LAFAYETTE RADIO

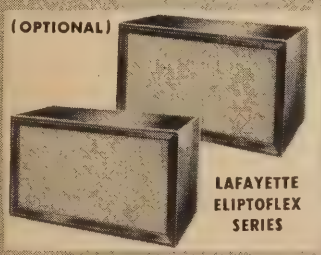
165-08 LIBERTY AVE., JAMAICA 33, N. Y.
AXtell 1-7000

NEW YORK, N. Y.	BOSTON, MASS.	BRONX, N. Y.	NEWARK, N. J.	PLAINFIELD, N. J.
100 6th Ave.	110 Federal St.	542 E. Fordham Rd.	24 Central Ave.	139 W. 2nd St.
WOrth 6-5300	HUbbard 2-7850	FOrdham 7-8813	MArket 2-1661	PLainfield 6-4718

NEW! *Lafayette* 50 Watt Complete Stereo Phono System







COMPONENTS

LAFAYETTE LA-250 50-WATT STEREO AMPLIFIER	89.50
GARRARD RC121/11 STEREO CHANGER	41.65
NEW GE VR-22 (.7 MIL) DIAMOND STEREO CARTRIDGE	24.45
LAFAYETTE PK-111 WOOD CHANGER BASE	3.95
2-LAFAYETTE SK-58 FAMOUS FREE EDGE 12" COAXIAL SPEAKERS at 29.50	59.00
Regular Catalog Price	~~218.55~~

COMPLETE STEREO SYSTEM

174.50

YOUR GUARANTEED BEST STEREO SYSTEM BUY!

YOU SAVE 44.05

This superb system will add a new dimension in living to your home with all the excitement and realism of a live concert. The new Lafayette LA-250, 50-watt stereo amplifier (25 watts each channel) forms the heart of this outstanding stereo hi-fi phonograph music system—the features, versatility and advanced circuitry of this unit are second to none. Also included is the famous Garrard RC121/11 intermix 4-speed automatic record changer with full manual or automatic operation supplied with your choice of stereo cartridges—the new GE VR-22 (.7 Mil) diamond stereo cartridge, Pickering 371-7D (.7 Mil) diamond stereo cartridge, Shure M7D (.7 Mil) diamond stereo cartridge or the new Electro-Voice 31 MD7 (.7 Mil) diamond stereo cartridge. Supplied with the Lafayette wood base cut for the RC121 in your choice of finishes. These outstanding components are coupled with the 2 famous free edge Lafayette SK-58 12" Coaxial speakers with built-in crossover network and brilliance level control. System supplied with plugs, cables and simple instructions. Shpg. wt., 67 lbs.

HF-681WX Hi-Fi STEREO PHONO SYSTEM with choice of cartridge and mahogany, walnut or blond changer base (please specify) 5.00 Down ..... Net **174.50**

HF-683WX Same as HF-681, but with 2 Lafayette Eliptoflex Series Bookshelf Enclosures (please specify finish). Shpg. wt., 143 lbs. 10.00 Down ..... Net **229.95**

HF-682WX Stereo AM-FM-Phono System. Same as HF-681 but including the Lafayette LT-50 stereo tuner. Shpg. wt., 85 lbs. 28.75 Down, 10.00 Down ..... Net **287.50**

Leaders in Hi-Fi

The most complete selection and largest stocks of hi-fi components and systems—available for immediate delivery at the lowest possible prices. Save even more on Lafayette endorsed "best-buy" complete systems.

FREE!

1960 CATALOG

308 GIANT SIZED PAGES

The Complete Catalog Featuring
"The Best Buys In The Business"

FOR THE NEWEST AND FINEST IN
STEREOPHONIC HI-FI EQUIPMENT AND SYSTEMS

- TAPE RECORDERS
- PUBLIC ADDRESS SYSTEMS
- AMATEUR EQUIPMENT
- INDUSTRIAL SUPPLIES
- MINIATURE COMPONENTS
- RADIO & TV TUBES AND PARTS
- EXCLUSIVE LAFAYETTE TRANSISTOR & HI-FI KITS

Send for Lafayette's FREE Catalog—the most complete, up-to-the-minute electronic supply catalog crammed full of everything in electronics at our customary down-to-earth money-saving prices.

A "must" for the economy-minded hi-fi enthusiast, experimenter, hobbyist, engineer, technician, student, serviceman and dealer.

Lafayette Radio

"Everything in Electronics"

FREE

LAFAYETTE RADIO, Dept. JA-6
P.O. Box 222, Jamaica 31, N. Y.
308 GIANT SIZED PAGES — FREE

Name .....

Address .....

City ..... *State* .....

SERVICE RADIO and TV
FAST!
HANDLE MORE JOBS...
MAKE MORE MONEY

TIME and know-how are your two best servicing tools. Are you making the most of them? These two Gernsback Library books show you how. Now spot hundreds of tough TV and radio troubles in seconds. Fix them in minutes. With these handy alphabetized listings of symptoms, troubles and cures you can tame the toughest "dog." Complete, cross-referenced where necessary. Hundreds of helpful photos, schematics, and troubleshooting charts. Be the most successful technician in your neighborhood—keep these two books on your workbench. Watch your servicing time speed up and your income climb! **Get your copies today.**

RAPID TV REPAIR — G/L Book No. 60
RAPID RADIO REPAIR — G/L Book No. 78
By G. Warren Heath
Paper covered editions $2.90 ea.
Deluxe hard-cover editions $4.60 ea.

SEE YOUR DISTRIBUTOR OR Mail this coupon today

OTHER HELPFUL G/L BOOKS
Paper cover editions

No. 81	Printed Circuits	$2.90
No. 77	Guide to Mobile Radio	$2.85
No. 76	Servicing Transistor Radios	$2.90
No. 72	Oscilloscope Techniques	$2.90
No. 68	TV and Radio Tube Troubles	$2.90
No. 65	Servicing Color TV	$2.90
No. 62	TV—It's a Cinch	$2.90
No. 59	Servicing Record Changers	$2.90

GERNSBACK LIBRARY INC., Dept. 10
154 West 14th St.
New York 11, N. Y.

Please send me the books below postpaid

No. 60 ☐ hard cover ☐ paper cover
No. 78 ☐ hard cover ☐ paper cover

☐ 81 ☐ 77 ☐ 76 ☐ 72
☐ 68 ☐ 65 ☐ 62 ☐ 59

Name_____
please print
Street_____
City_____ Zone____ State_____

STYLUS PRESSURE GAUGE

Precision stylus pressure gauges are available in 10 models ranging in calibration from .5 to 5 gram range up to 200 to 2000 gram range.

Cat. No. 6385, shown above, with 2-15 gram range or 3/32 to 1/2 oz. range $11.65

The extra indicator "hand" will remain at the maximum reading of the device until reset by a knob on the dial face.

CORRECT STYLUS PRESSURE NOT ONLY GUARANTEES MINIMUM STYLUS AND RECORD WEAR, BUT ASSURES SOUND PICK-UP AT MINIMUM DISTORTION.

For Complete Information request our 96 Page Catalog — Contact any of our 4 "Coast to Coast" Locations or your nearest Local Distributor.

SCHERR-TUMICO
PRECISION MEASURING TOOLS AND INSTRUMENTS

WAREHOUSE STOCK, SHOWROOMS & SALES OFFICES AT
NEW YORK: 200 Lafayette Street, New York 12, N. Y.
ST. JAMES: St. James, Minnesota
LOS ANGELES: 3337 West Olympic Blvd., Los Angeles 19, Cal.
CHICAGO: 5045 W. Harrison, Chicago 44, Ill.
When writing to any of the above locations, refer to DEPT FF-1

AMATEUR TELEVISION EQUIPMENT

For 420MC to 450MC BAND

TV TRANSMITTER MODEL TV-1 $365.00
SCHEMATIC DIAGRAM FOR TV-1 $2.00
POWER SUPPLY MODEL PS-1 $200.00
SCHEMATIC DIAGRAM FOR PS-1 $1.25
TV TRANSMITTER MODEL TV-2 $565.00
POWER SUPPLY MODEL PS-2 $250.00
30 WATT OUTPUT

All prices are net. F.O.B. Hazleton, Penna.
Amateur and Closed-Circuit Studio and Transmitting TV Systems
Bob Schnaufer, W3SCV
SCHNAUFER DEVELOPMENT CO.
536 Pardee Street Hazleton, Penna.

LEARN THE SHORT-CUTS
Professional TELEVISION
All-Practice TRAINING

Jump your earnings fixing black-and-white and color sets. Get into the top-pay bracket. NRI's concentrated spare time, low-cost training can do it for you. You'll fix sets faster, easier. Special course for Radio and TV servicemen — not for beginners. Full information free. Mail coupon now:
NATIONAL RADIO INSTITUTE, Dept. 08FT, Wash. 16, D.C.

NATIONAL RADIO INSTITUTE
Dept. 08FT, Washington 16, D.C.
Without cost or obligation send me facts about your Professional All-Practice TV Course.

Name-----Age-----
Address-----
City-----Zone-----State-----
ACCREDITED MEMBER NATIONAL HOME STUDY COUNCIL

BOOKS *(Continued from page 152)*

radio models from many manufacturers. It provides photos, diagrams and schematics. The text tells how to proceed to find the defect quickly. The last section incorporates much useful transistor data.—*IQ*

18 STEREO AMPLIFIERS, tested and evaluated by American Audio Institute, 394 E. 18 St., Paterson, N. J. 5½ x 8½ in. 65 pp. $2.50.

Tabulated results of 19 tests on each of 18 integrated stereo amplifiers are weighted and evaluated to provide comparative amplifier ratings for engineer, audiophile or prospective purchaser. The tests are explained in detail in the introduction. Amplifiers made by Bell (four models), Bogen (two), Fisher, G-E (two), Harman-Kardon (three), Pilot (two), Scott (two), Sherwood and Stromberg-Carlson are reported on.

PROPERTIES, PHYSICS AND DESIGN OF SEMICONDUCTOR DEVICES, by John N. Shive. D. Van Nostrand Co., Inc., 120 Alexander St., Princeton, N. J. 6 x 9 in. 487 pp. $9.75.

To most of us, transistors dominate the field of semiconductors, but thermistors, varistors and photocells also have important uses. This book covers *all* these devices, while emphasizing transistors. It is prepared for the upper-class student or graduate to pave the way for advanced study.

Part 1 analyzes the behavior of each of the above semiconductors and gives its chief applications. Part 2 goes deeper into the theory and physics of each. The book is well illustrated with diagrams and photos, and gives a good balance of theory and practice.—*IQ*

OFFICIAL REGISTRY OF PUBLIC SAFETY RADIO SYSTEMS (1959). Edited by Ethel V. Sleeper. Communications Engineering Book Co., Monterey, Mass. 8½ x 11 in. 162 pp. $4.

A directory listing call signs, frequencies, addresses, the number of mobile units authorized and the manufacturer of transmitters used in stations operated by municipal, county, state, zone and interzone police; fire departments, special emergency, highway maintenance, forestry conservation services and local governments. In Part 1, the licensees are listed alphabetically by state and city. Part 2 has listings by frequency with call signs, location and type of service.

SILICON ZENER DIODE HANDBOOK, Motorola, Inc., Semiconductor Div., 5005 E. McDowell, Phoenix, Ariz. 5½ x 8½ in. 126 pp. $1.

This handbook is concerned with the theory, design characteristics and applications of the Zener diode—a special kind of semiconductor voltage-limiting diode. It is illustrated with characteristic curves, schematic diagrams and charts. An accompanying Zener Diode Slide Rule Calculator ($1) quickly and easily solves the problems associated with the design of Zener diode circuits.

END

NEW!

RESIST-O-PANEL

FREE ! with any of 4 Handy-Pak Carbon Resistor Assortments

10 Values

$7.20 to $14.40 Dealer Net

Requires no bench space | Contains 10 Handy-Paks with space for 10 more | Wall Brackets Included

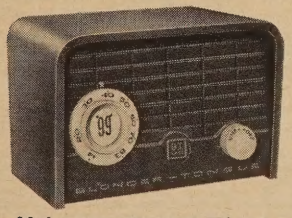
IRC

Order from your IRC Distributor

INTERNATIONAL RESISTANCE COMPANY
DISTRIBUTOR SALES DIVISION
414 N. 13th STREET • PHILADELPHIA 8, PA.

add all UHF channels to your tv set

BLONDER-TONGUE MODEL 99R UHF CONVERTER



Make your present TV set a modern 82-channel receiver

■ sharper, clearer pictures ■ easy, one-knob tuning ■ drift-free performance—no fading ■ approved for color TV ■ UL approved ■ tuned input

Outperforms all others in its class. The nation's biggest selling UHF converter. Only

22.95

For fringe areas—the powerful Blonder-Tongue Ultraverter Model BTU-2R, 39.95. Sold by parts distributors. RE-1

B-T LABS

BLONDER-TONGUE LABORATORIES, INC.
9 Alling St., Newark 2, N. J.

ADVERTISING INDEX

Radio-Electronics does not assume responsibility for any errors appearing in the index below.

Aerovox Corp. 88
Airex Radio Corp. 140
Allied Radio Corp. 9, 92–95, 107
American Television & Radio Co. 79
Amphenol-Borg Electronics 132
Arkay International Inc. 109
Astatic Corp. ..... Inside Front Cover
Atlas Sound Corp. 117
Audion 144

B & K Mfg., Co. 91, 137
Barry Electronics Corp. 157
Beam-Echo International Ltd. 89
Blonder-Tongue Labs 157
Bogen Co., Inc. 98
Bonafide Radio 140
Brooks Radio & Television Corp. 125
Burroughs Corp. 119
Burstein-Applebee Co. 129

CBS Electronics 12
Capitol Radio Engineering Inst. 100–103
Capitol Record Club 158
Carston Studios 140
Castle Television Tuner Service 136
Centralab Div. of Globe Union 18
Century Electronics Co., Inc. 122–123
Cisin (H.G.) 140
Cleveland Inst. of Radio Electronics 11
Columbia Record Club 13
Cook (Wallace) 118
Cornell-Dubilier Electric Corp. 28
Coyne Electrical School 17, 99, 144

DeVry Technical Inst. 7
DeWald, Div. of United Scientific Labs Inc. 138
Dressner 118

Electro-Sonic Labs 146
Electronic Chemical Corp. 78
Electronic Instrument Co. (EICO) 29, 30
Electronic Measurement Corp. 104
Electronic Publishing Co., Inc. 106
Electric Soldering Iron Co. 152
Electro-Voice, Inc. 80–81
Esse Radio Co. 134
E-Z Hook Test Prods., Co. 98

Fisher Radio Corp. 76
Foreign Components Co. 144

Gernsback Library, Inc. 128, 156
Gonset Div. of Young Spring & Wire Corp. 120
Grantham School of Electronics 15
Grommes Div. of Precision Electronics 117
Guide Lamp Div. of General Motors Corp. 10

Hallicrafters 149
Harman-Kardon ..... Inside Back Cover
Heald Engineering College 140
Heath Co. 66-73, 75
Hi-Fidelity Centre 121
Hi-Par Products 106
Homewood Industries 146

Illinois Condenser Co. 134
Indiana Technical College 121
International Business Machines 86–87
International Resistance Corp. 157

JFD Electronics 3
Jensen Industries 152
Jerrold Electronics Co. 24

Kedman Co. 144
Key Electronics Co. 134
Kingston Electronics 85
Lafayette Radio 154-155

Lektron Inc. 127

Moss Electronics 112-115

National Radio Institute 19-20, 156
National Schools 5

Olson Radio Corp. 117
Opportunity Adlets 142–143
Orr Industries Inc. 152

Paco Electronics Co., Inc. 116
Philco Techrep Div. 90
Picture Tube Outlet 144
Planet Sales Corp. 133
Precision Electronics 117
Prentice-Hall, Inc. 104
Progressive "Edu-Kits" Inc. 147

Quam-Nichols Co. 78
Quietrole Co., Inc. 104

RCA Electron Tube Div. ..... Back Cover
RCA Institutes 26-27
Radio-Electronics Master 118
Radio Shack Corp. 135
John F. Rider Publishers 142
Rinehart & Co., Inc. 22–23
Rohn Mfg. Co. 77

Sams (Howard W.) & Co. 130–131
Scherr-Tumico 156
Schnaufer Development Co. 156
Scott, Inc. 21
Service Instruments Corp. 139, 141, 143, 145
Sherwood Electronic Labs., Inc. 126
Sonotone Corp. 8
Sprague Products Co. 16
Sprayberry Academy of Radio TV 25
Supreme Publications 149

TAB 148
Tarzian (Sarkes), Inc. 98
Telectrosonic Corp. 150
Teltron Electrical Co. 121
Tung-Sol Electric Co. 14

United Audio Products 99, 106
University Loudspeakers 88

Vanguard Electronic Labs. 148
Vidaire Electronics Mfg. Corp. 121

Wigo 99
Wuerth Tube Saver Corp. 118

Zalytron Tube Co. 151

SCHOOL DIRECTORY PAGE 153

Baltimore Technical Institute
Candler System Co.
Indiana Technical College
International Correspondence School
Milwaukee School of Engineering
Pacific International College of Arts & Sciences
Philadelphia Wireless Technical Inst.
Philco Techrep Division
Tri-State College
Valparaiso Technical Institute

BRANCH ADVERTISING OFFICES: Chicago: 5500 N. Menard Ave., Chicago, SPring 4-1444. Los Angeles: Harker-Husted-Coughlin, 600 South New Hampshire, Tel. DUnkirk 7-2328. San Francisco: Harker-Husted-Coughlin, 444 Market St., Tel. GArfield 1-2481.
FOREIGN AGENTS: Great Britain: Atlas Publishing and Distributing Co., Ltd., 18 Bride Lane, London E.C. 4.
Printed in the United States of America

BARRY BEST BUYS

- **Xmas Special — Imported European Antique Telephone.** Beautiful condition. Reconditioned. In working order. **$19.95 each (2 for $30.00).** Collector's Gem.
- **G.E. Capacitors** 1 Mfd. @ 6 KV. Original boxed, unused. **$4.95**
- **Leach Power Relays** 115 VAC. 30 amp contacts (N.O.) **$4.95**
- **9 Ft. RG41/U Coax Cords,** with 83-ISP connectors on each end. ..... **$1.00 each**
- **New Silicon Rectifier.** Input: 130 Volts at 500 Ma. Price ..... **75¢ each (10 for $7.00)**
- **Audio Devices type 20E5 Silicon Rectifier.** 750 Ma. (130 V.RMS) ..... **90¢**
- **Audio Devices Silicon Rectifier.** Input: 130 VAC @ 250 Ma. Price .... **55¢ ea. (ten for $5.00)**
- **7 Conductor Intercom Cable** (color-coded) ..... **6¢/ft.**
- **Sonotone Rechargeable Battery Cartridge Model FC-2.** Write for details. **$7.95**
- **Raytheon Power Supply.** Input: 6 VDC. Output: 117 VAC @ 60 CPS (50 watts conservative) New **$16.95**
- **TS-78/U Tune-Up "Dummy" Load.** Excellent for Citizens Band or VHF. **$1.00**
- **LM-21 Navy Freq. Meter** (125 to 20,000 KCS.) **$75.00**
- **BC-221 Army Freq. Meter** (125 to 20,000 KCS.) **$85.00**
- **Powell Announcer with Speaker.** This device plays a tape-recorded message over & over again. Unused, original packing. Operates on 115 VAC. **$37.50**
- **Westinghouse Scope Transformer** Pri: 115 VAC @ 60 CPS (16.5 VA.) Sec: 2.5 Volts @ 3 Amps. Sec: 3890 V. @ .0023 Amps. Brand new. Weight: 9 lbs. **$3.95**
- **Aircraft-Lab Type Selenium Rectifier.** Full-wave bridge type. Input: 450 VAC (RMS) Output: 350 VDC @ 340 Ma. Encapsulated. Hermetically sealed. Oil Filled. **$7.95**
- **Scintillation Counter.** Brand new. Orig. cartons. Ready to operate with fresh set of batteries. Ten times more sensitive than usual Geiger Counter. Write for brochure. Reg. $245.00. Special price **$49.95**
- **HS-30 Headsets.** Hi-impedance (10,000 Ohms) with transformer, cord & plug. Used, like-new condition. ..... **$1.59 each (10 for $15.00)**
- **RCA Magic Brain Remote TV Control.** For remote control of many RCA TV sets. Complete in original RCA box. Write for details. Brand new. **$13.95**
- **7 Ft. Relay Racks** with front and back doors. New. Beautiful grey. With hardware..... **$49.95**
- **Choke 50 Hy. @ 120 Ma.** Herm. sealed. 6½ lbs. **$1.00**
- **Altec. Lansing Hi-Fi Output Xfmr.** Pri: 3300 ohms; Sec: 500/250 Ohms @20 Watts. ±1 DB from 20 to 20,000 CPS. 10 lbs. **$4.95**
- **TCS Noise Limiter Adapter Unit.** With spec. sheet. 1 lb. Price ..... **99¢**
- **Xmas Special—Deluxe $29.95 Chrome plated Shoe-Dryer.** (115 VAC) Ideal for golfers, children, gardeners, etc. Special price..... **$9.95**
- **Xmas Special—Hands-Free Telephone Cradle-Amplifier.** No wires. Completely transistorized & battery operated. Free to speak and listen without holding phone. Time-saver. Beautiful beige finish. **$44.00**
- **.35 Hy. 2 Amp. Choke** (2.2 Ohms DC resistance) Hermetically sealed **$4.95**
  Open Frame **$3.95**
- **Hammarlund Super-Pro SP600 Receiver.** Excellent condition, lab tested. **$450.00**
- **Ling Closed-Circuit TV Camera.** Brand new. Write for details. ..... **Approx. $600.00**
- **Evans Gasoline-Kerosene Heaters.** Value $100.00. Brand new. Special **$5.00**
- **Geloso Tape Recorder** for Ham, entertainment or business use. Brand new. 6½ lbs. Write for details.
- **Plate Transformer.** Sec: 6,000 -0- 6,000 VAC @ 400 Ma. Pri: 117 VAC @ 60 CPS. 108 lbs. Compact. **$70.00**
- **Matching Choke** to above xfmr. 10 Hys. @ 750 Ma. 10 KV insulation. **$13.00**

Write for catalog. Largest, diversified, special-purpose, TV & Radio tube stock in USA at sensible prices Authorized factory distributors for CBS, Eimac, National Electronics, WESTINGHOUSE, etc.

Prices F.O.B. NYC. Minimum order $5.00. All mdse. guaranteed. (Cost of mdse. only.)

BARRY
ELECTRONICS CORP.

512 BROADWAY, DEPT. RE-1
New York 12, N.Y.
WAlker 5-7000

Choose from The KINGSTON TRIO, Nat King COLE, ERNIE FORD and All These Great STARS!

Take 4 12" LONG PLAY HIGH FIDELITY CAPITOL ALBUMS

RETAIL VALUE UP TO $19.92—PAY ONLY

97¢

PLUS A SMALL CHARGE FOR POSTAGE, PACKING AND MAILING

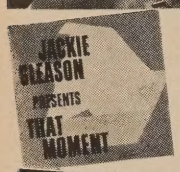
When you become a Trial Member of the Capitol Record Club and agree to buy as few as six future record selections at the usual retail price during the next 12 months.

KINGSTON TRIO

98. Songs that made them famous: *Tom Dooley, Three Jolly Coachmen* and many others from calypso to sea chanties. $3.98

NAT KING COLE

104. Twelve great songs, as only Nat can sing them. Hear *Just One of Those Things, Who's Sorry Now,* many more. $4.98

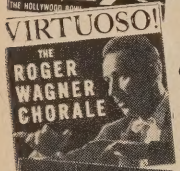


JACKIE GLEASON

147. Two full string sections and Bobby Hackett's pure trumpet evoke "that moment" between boy and girl. Mood magic! $4.98

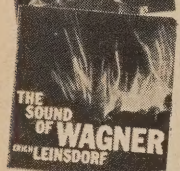
GEORGE GERSHWIN

1. His most famous compositions—*Rhapsody in Blue* and *An American in Paris* Leonard Pennario and the Hollywood Bowl Sym. $4.98



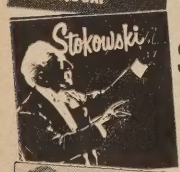
ROGER WAGNER CHORALE

111. Hear breathtaking performances of Handel's *Hallelujah Chorus,* music from *Prince Igor,* works by Mozart and others $4.98



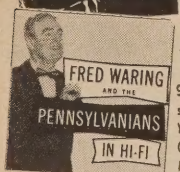
ERICH LEINSDORF

89. Leinsdorf conducts excerpts from Wagner's most thrilling works—*Lohengrin, Die Meistersinger, Tannhauser,* others. $4.98



LEOPOLD STOKOWSKI

2. The most celebrated living conductor performs the outstanding landmarks of his career—by Bach, Debussy, Strauss, etc. $4.98



FRED WARING

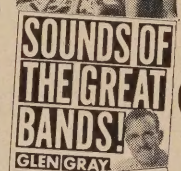
99. Fred directs the Pennsylvanians in 12 favorites *You'll Never Walk Alone, Ol' Man River, Smoke Gets In Your Eyes,* others. $4.98

Stan Kenton

6. The greatest in "progressive jazz"—*Lover, Peanut Vendor, Painted Rhythm,* many others $4.98

GEORGE SHEARING

101. Shearing piano with instrumental background—*What Is There to Say, Black Satin,* eight others $3.98

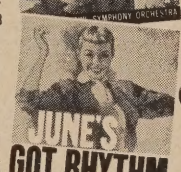


Glen Gray

115. Glen and his Casa Lomans recreate the sounds of Krupa, Dorsey, Miller, Shaw and others $4.98

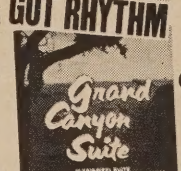
STARLIGHT Waltzes

126. The music of Strauss, Tchaikovsky, Sibelius, others by Felix Slatkin and Hollywood Bowl Symphony $4.98



JUNE CHRISTY

107. June sings *When Lights Are Low, They Can't Take That Away From Me* nine others $3.98



FERDE GROFÉ

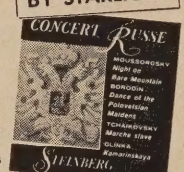
122. Grand Canyon Suite and Mississippi Suite by Felix Slatkin and the Hollywood Bowl Symphony $4.98

Gaite Parisienne

110. Offenbach's exuberant ballet music brilliantly performed by Felix Slatkin and the Hollywood Bowl Symphony Orchestra. $4.98

HOLLYWOOD BOWL SYMPHONY

118. Hear Frederick Chopin's greatest music sparkling polonaises, waltzes, etudes in superb orchestral performances. $4.98

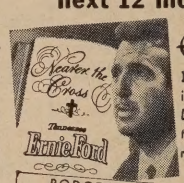


WILLIAM STEINBERG

109. William Steinberg and the Pittsburgh Symphony Orchestra play works by Tchaikovsky, Moussorgsky, Glinka and Borodin $4.98

JONAH JONES

103. The famous Jones combo in a swingin' new set of tunes: *Just A Gigolo, Night Train,* ten other favorites. $3.98



Ernie Ford

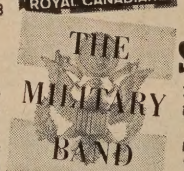
105. Tennessee Ernie sings inspiring hymns: *Now the Day Is Over, Nearer My God to Thee, Rock of Ages* and nine other favorites. $3.98

RODGERS and HAMMERSTEIN

102. Movie sound track of *Carousel* with Gordon MacRae and Shirley Jones. They sing *If I Loved You, You'll Never Walk Alone,* etc $4.98

Guy LOMBARDO

100. Guy and the Royal Canadians play 40 Irving Berlin hits: *Say It Isn't So, Be Careful It's My Heart,* many more $3.98



FELIX SLATKIN

119. Slatkin conducts America's favorite band music *The Stars and Stripes Forever, Anchors Aweigh,* 11 other marches $4.98

HOW TO SAVE MONEY on the Albums you want... from the greatest of classics... to the biggest of hits!

YOU GET FOUR ALBUMS—WORTH UP TO $19.92 (retail value) as a trial member of the Capitol Record Club and pay only 97¢. As a member you agree to buy six additional records during the next 12 months *from over 200 to be offered!* Then you may resign, or retain membership by buying only 3 albums annually with full bonus credit. For the records you buy, you pay only the usual retail price plus a small charge for postage, packing and mailing.

MORE FREE ALBUMS! Each time you buy two more records after your agreed upon six future selections, you may choose a 12" long-play BONUS ALBUM worth $3.98 or $4.98, from a list of current Capitol best sellers. . .FREE!

UNLIMITED CHOICE! Each month you receive the Record Club Review, describing the month's selections. If you want the selection in the division you joined (Classical . . Best-Seller Hits and Show Music . . or Hi-Fi Jazz), do nothing; it will come automatically. If you wish *any* of the *other* selections—or no record that month—simply notify the Club on the form always provided.

BUT HURRY to get your FOUR ALBUMS—and pay only 97¢! The first three are Bonus Albums which will be earned when you buy your second, fourth and sixth additional albums (at the rate of one every other month), but which are given to you now in advance.

SEND NO MONEY—RISK NOTHING! If not delighted, return the four albums within 7 days and your membership and all charges will be cancelled without further obligation. Mail coupon to: The Capitol Record Club, Dept. 5055, Scranton 5, Pennsylvania.

CAPITOL RECORD CLUB Dept. 5055, Scranton 5, Pennsylvania

Please accept my application for trial membership in the Capitol Record Club. Send me at once the 4 ALBUMS which I have indicated below. The first 3 are Free. All you will bill me is 97¢ plus a small charge for postage, packing and mailing.

During the next 12 months I agree to buy 6 additional records from about 200 to be offered, at the usual retail price of $3.98 or $4.98 (plus a small charge for postage, packing and mailing) I will purchase at least one record every two months and will send you payment 7 days after receipt of each record. I may cancel my membership after buying 6 additional records. Or, if I then remain a member I will select a FREE BONUS album each time I purchase two records.

THESE ARE THE FOUR ALBUMS I CHOOSE (write numbers in boxes) ☐ ☐ ☐ ☐

CHECK THE DIVISION IN WHICH YOU WISH TO BE ENROLLED

1. ☐ **Best Seller Hit Albums (Dancing, Listening, Mood Music and Show Albums from Theatre, Screen and TV)**
2. ☐ **Classical Albums**
3. ☐ **Hi-Fi Jazz**

☐ **Check here if you own a STEREO record player and agree to buy your 6 future selections in STEREO.** Then the four records you have chosen above will be sent you in STEREO with a bill for only $1.00 more ($1.97). Future selections and FREE Bonus Albums will be STEREO Albums which usually retail for $1.00 more than monaural. **NOTE:** Stereo records can be played only on stereo equipment.

NO-RISK GUARANTEE: If not delighted, I will return these 4 ALBUMS within 7 days and my membership and all charges will be cancelled without further obligation.

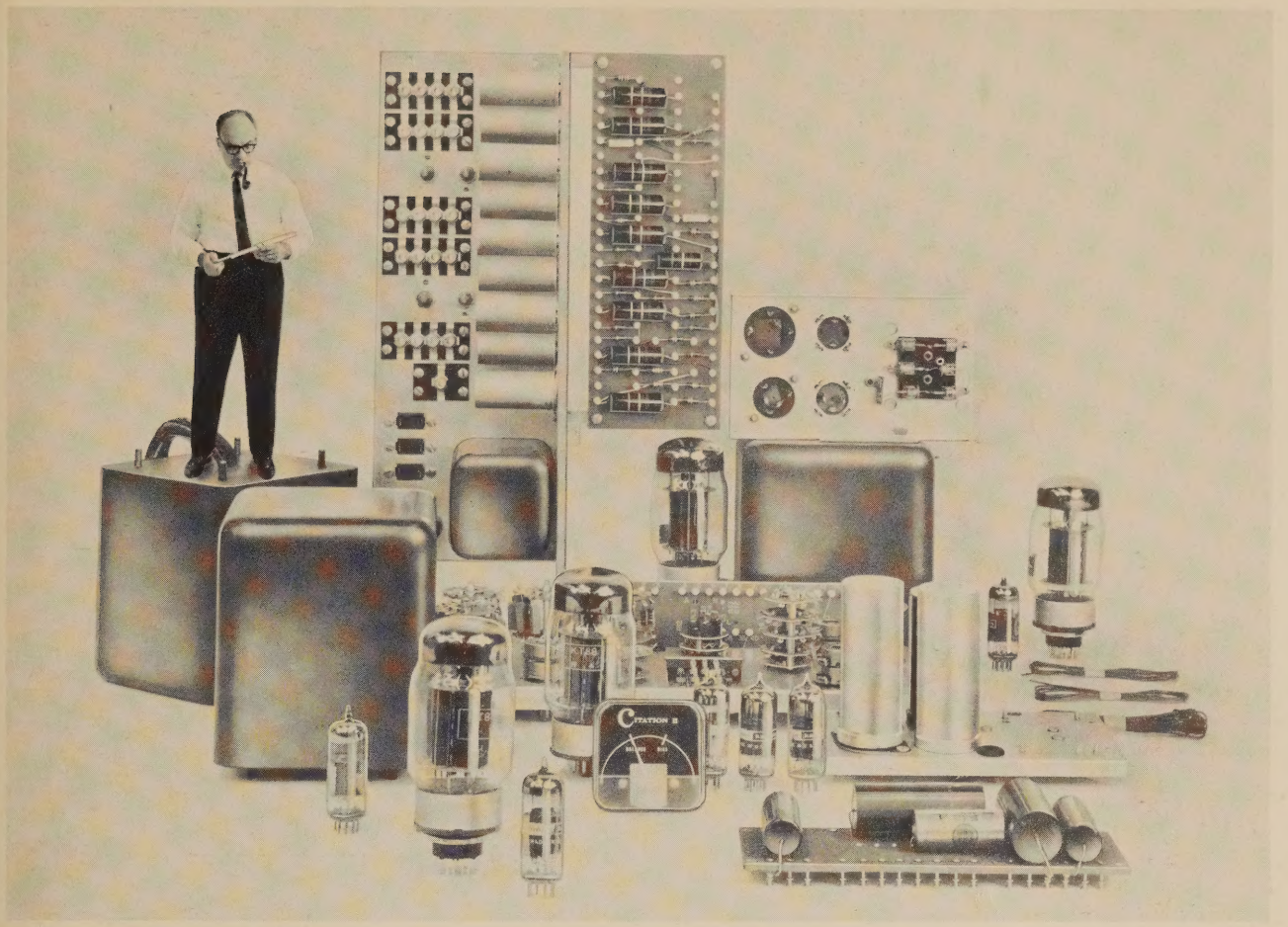
PRINT NAME .....

ADDRESS .....

CITY ..... ZONE ..... STATE .....

Please send no money. We will send you a bill. (*Membership limited to one per household.*) Slightly higher in Canada. Address Capitol Record Club of Canada, 1184 Castlefield Ave., Toronto 19.

If you wish to join through a CAPITOL record dealer authorized to solicit Club subscriptions, write his name and address in the margin. RE-1



We don't pack an engineer into each new Citation Kit but...

...the engineering *built into* each kit is so precise that the unit constructed in the home will be the equal of the factory-produced instrument.

It is far more difficult to design a kit than to produce a completely manufactured product. In the plant the engineer can control his design from the moment of inception until the final packaging. The kit builder has only his tools, his ingenuity and little, if any, test equipment.

Therefore, the complex process of in-plant production and control which guarantees the fine finished product must somehow be *embedded* in the kit design. The Citation engineering group at Harman-Kardon, headed by Stewart Hegeman, has succeeded in doing just this in the design of the new Citation I, Stereophonic Preamplifier Control Center and Citation II, 120 Watt Stereophonic Power Amplifier.

Only heavy duty components, operating at tight tolerances, have been selected for the Citation Kits. As a result, even if every component is operated at its limit — remote as this possibility is — the instruments will perform well within their specifications.

Rigid terminal boards are provided for mounting resistors and condensers. Once mounted, these components are suspended tightly between turret lugs. Lead length is sharply defined. The uniform spacing of components and uniform lead length insure the overall stability of the unit.

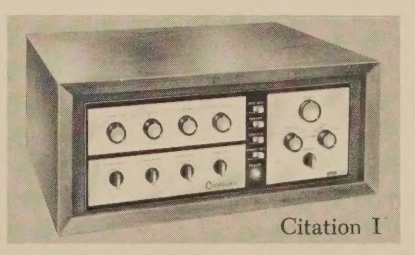
Improper routing of leads, particularly long leads, can result in unstable performance. To prevent this, the Citation II is equipped with a template to construct a Cable Harness. The result: each wire is just the right length and in just the right place to achieve perfect performance.

These truly remarkable achievements in Control Engineering are only a few of the many exciting new developments in kit design from the Citation Division of Harman-Kardon.

THE CITATION I, *Stereophonic Preamplifier Control Center,* is a brilliantly designed instrument, reflecting engineering advances found only in the best professional equipment. The control over program material offered by the new Citation I enables the user to perfectly re-create every characteristic of the original performance. (The Citation I — $139.95; Factory-Wired — $239.95; Walnut Enclosure, WW-1 — $29.95.)

THE CITATION II, *120 Watt Stereophonic Power Amplifier,* has a peak power output of 260 Watts! This remarkable instrument will reproduce frequencies as low as 5 cycles virtually without phase shift, and frequencies as high as 100,000 cycles without any evidence of instability or ringing. *At normal listening levels, the only measurable distortion in this unit comes from the laboratory testing equipment.* (The Citation II — $159.95; Factory-Wired — $219.95; Charcoal Brown Enclosure, AC-2 — $7.95.) All prices slightly higher in the West.

Harman-Kardon has prepared a free detailed report on both of these remarkable new instruments which we will be pleased to send to you. Simply write to Dept. 100, Citation Kit Division, Harman-Kardon, RE1, Westbury, L. I.



Citation I

Build the Very Best CITATION KITS *by* harman kardon

Have you checked the big dealer profits on RCA Monogram Picture Tubes?

Head for your RCA Distributor... and get the facts firsthand!

RADIO CORPORATION OF AMERICA

Electron Tube Division — *Harrison, N. J.*